CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • MAY 1960

Transmission-line construction by helicopter

See article by F. R. PAYNE

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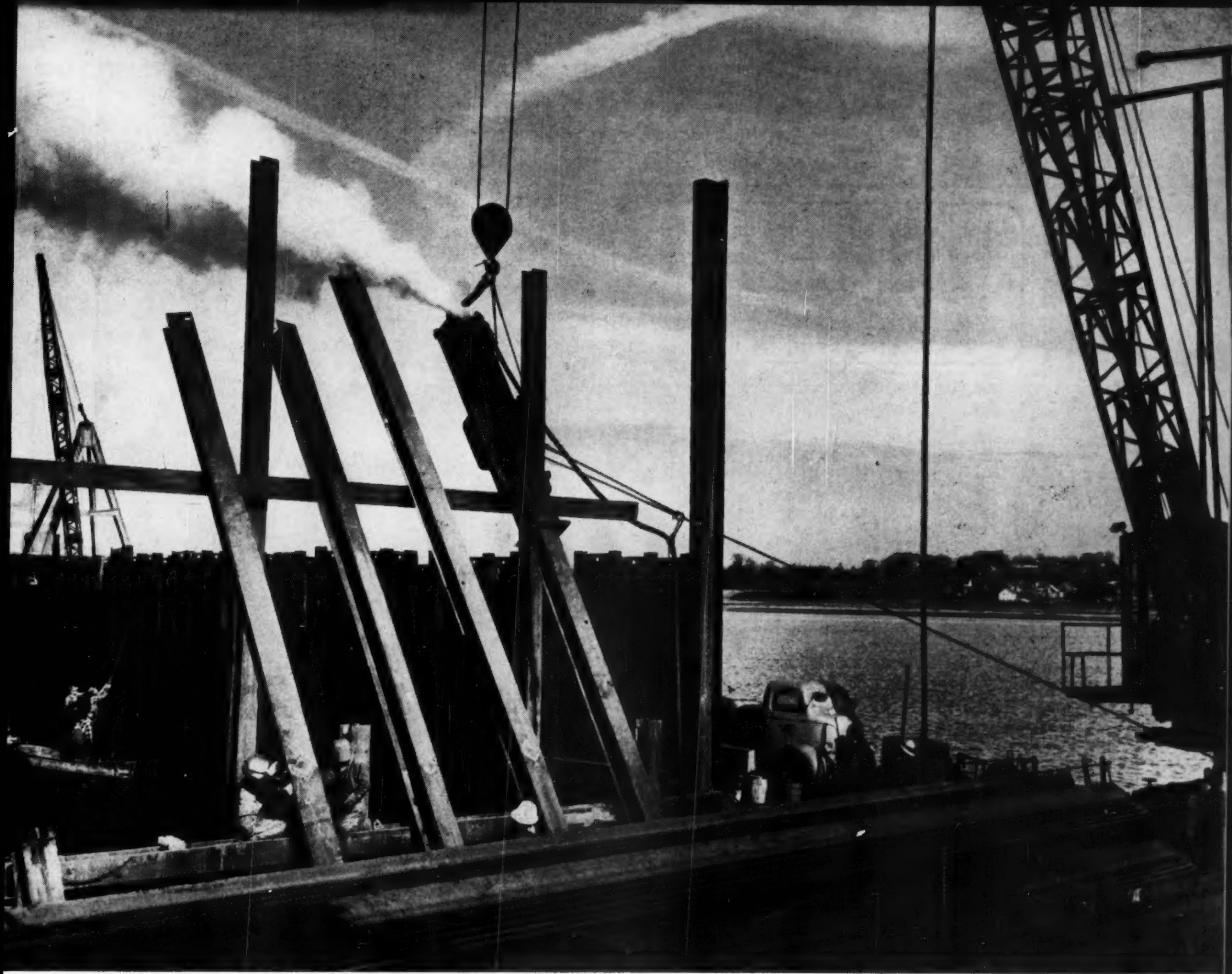
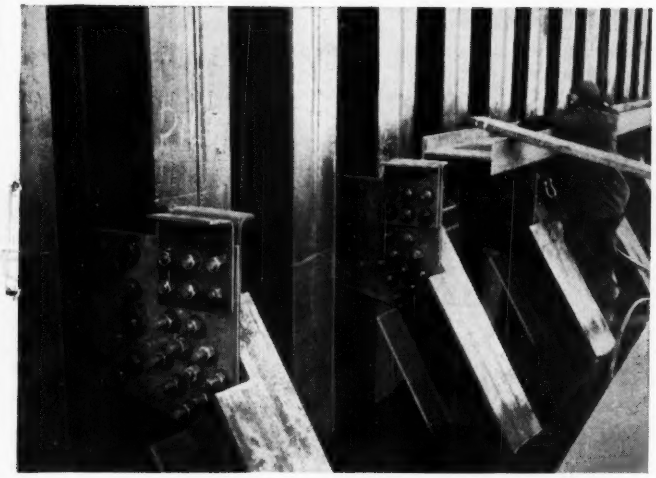
PROGRAM, RENO CONVENTION, JUNE 20-24



Steel piling bulkhead has batter piles 100-ft long



100-ft-long batter piles support the bulkhead at 6-ft intervals.

Construction of facilities at the new Brayton Point power station of New England Electric System included building a 1,160-ft long sheet piling bulkhead extending into the Taunton River opposite Fall River, Mass.

Using Bethlehem's ZP 32 and ZP 38 piles, the bulkhead protects a coal storage area which will hold 750,000 tons.

At six-foot intervals the bulkhead is braced by 100-ft-long batter piles driven at an angle to bedrock below the surface of the river and fastened to the bulkhead wale and wall by steel plates and Bethlehem high-strength bolts. At high tide, the wale is under water.

The Perini Corporation was general contractor for the bulkhead; New England Electric System designed it.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

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CIVIL ENGINEERING

MAY 1960
VOL. 30 • NO. 5

THE MAGAZINE OF ENGINEERED CONSTRUCTION

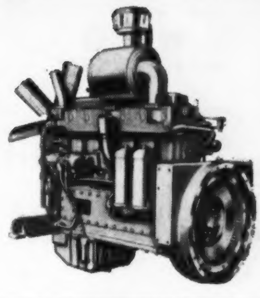
• ARTICLES

• ASCE NEWS

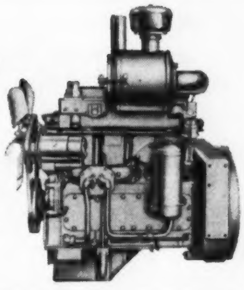
• DEPARTMENTS

FOR YOUR JOB?

with new compact engines!



New No. 12E Motor Grader features new compact 115 HP Engine



New No. 112E Motor Grader features new compact 85 HP Engine

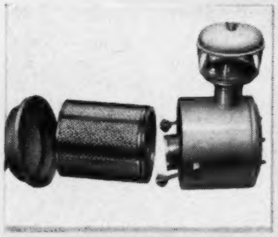
The new No. 112F is similar in appearance, but features a Turbocharged 100 HP Engine.

NEW HIGH TORQUE. Though the engines in the new Cat Motor Graders are designed specifically for each machine, they all develop higher torque than previous models and have other basic improvements in common. For example: shorter, stiffer blocks and crankshafts... stronger, distortion-resistant cylinder heads... improved cooling systems with greater capacity... engine lubricating oil conditioning... and advanced design fuel systems—new, compact fuel injection pumps with barrel and plunger assemblies in easy-to-service pump housings.

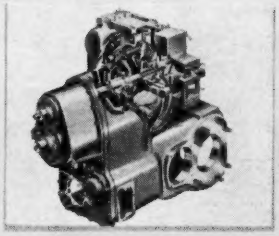
NEW STARTING ENGINE. Now standard is a new two-cylinder, vertical starting engine to replace the horizontal engine. All three Motor Graders use a modern 12-volt electric system. An optional 24-volt system is available for use in moderate climates where direct electric starting is practical.

PERFORMANCE-PROVED FEATURES. While many advances have been designed into the compact new engines, certain time-tested features have been retained. To mention a few: precombustion chamber design that delivers maximum horsepower on heavy, economy-type fuels... steel-back aluminum bearings . . . wet-type "Hi-Electro" hardened cylinder liners . . . and aluminum pistons with cast-in ring band.

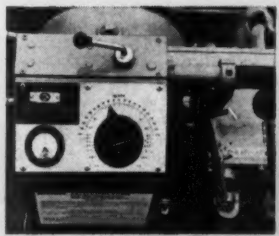
OTHER HIGH-PRODUCTION FEATURES IN CAT MOTOR GRADERS



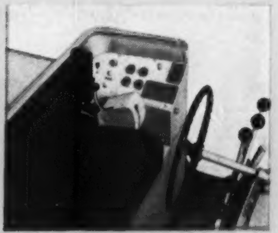
NEW DRY-TYPE AIR CLEANER (standard) removes a minimum of 99.8% of all dirt from intake air during every service hour. Can be serviced in 5 minutes. Cuts your maintenance time by as much as 70% and substantially reduces maintenance costs. Cleaner air also extends engine life.



EXCLUSIVE OIL CLUTCH (standard) provides up to 2000 hours service without adjustment, the equivalent of about 12 months of "adjustment-free" operation. A Caterpillar development proved by millions of hours of use, it virtually eliminates down time for clutch repair.



AUTOMATIC BLADE CONTROL (optional) cuts grading time in half. Operator sets desired slope on dial and only has to control depth of cut. Manufactured by Preco Incorporated, the unit automatically maintains blade slope within 1/8" in 10'. Available factory installed.



IN-SEAT STARTING (standard) offers operator finger-tip convenience and positive starts in any weather. Another feature: improved mechanical blade controls provide precise adjustment and ease of engagement. "Anti-creep" lock makes blade stay put under load.

Over-all length of cantilevered beams is 100′. Other 27 beams are 80′ long. All are 8′ wide at top and 3′ deep.

Single Tee Beams
FOR SPOKANE WAREHOUSE

Owner: Exchange Lumber & Mfgr. Company
Architect: Henry J. Swoboda
Structural Engineer: Jack M. Lyerla
Contractor: Walter G. Meyers & Sons
Prestressed Units: Central Pre-Mix Concrete Company
Concrete Block: Layrite Products Company
All of Spokane, Washington

Composed of just 35 prestressed concrete LIN TEE BEAMS, the roof of this building provides for an unobstructed floor area 80′ x 280′. And by adding a 20′ cantilever to eight of the beams, the loading entrance is given an attractive protective canopy.

Flexibility in design is only one of the reasons for the growing use of prestressed concrete in all types of construction. Others are its ease and speed of erection, low first cost, fire-resistance and negligible maintenance costs.

In the manufacture of prestressed units, such as these LIN TEES, Central Pre-Mix Concrete Company uses Lehigh Early Strength Cement. Like other manufacturers across the country, they have found that it affords them the most efficient, economical production cycle.

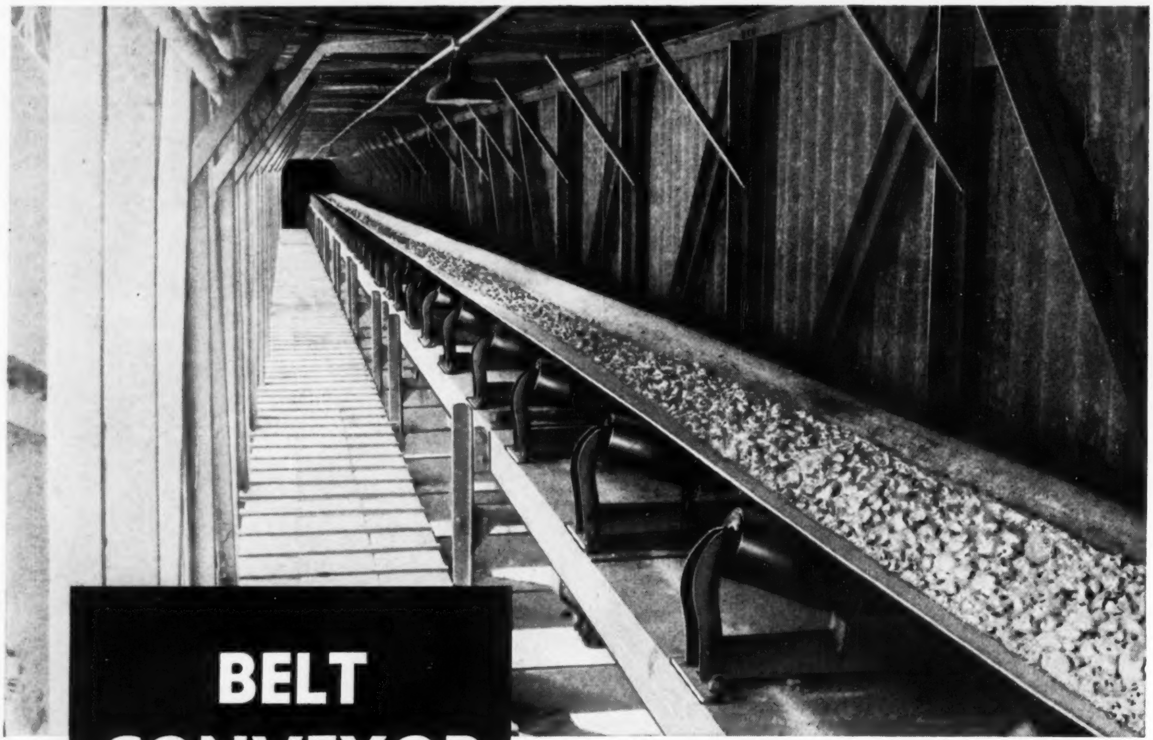
This is another example of the advantages of Lehigh Early Strength Cement and modern concrete construction.

Lehigh Portland Cement Company, Allentown, Pa.

LEHIGH CEMENTS

Two cranes place 100′ beam quickly and easily. Lehigh Early Strength Cement was also used in concrete block for masonry walls.

STEPHENS-ADAMSON

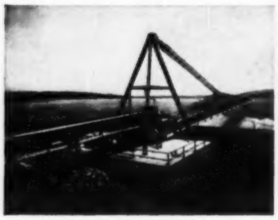


BELT CONVEYOR

handles greater tonnage at lower cost

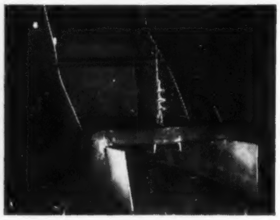
Tons of crushed stone and aggregates are carried fast, efficiently and at a lower cost per ton on STEPHENS-ADAMSON Belt Conveyors. S-A quality engineered conveyor components increase materials handling efficiency while reducing equipment "down time" to a minimum. Long-lasting, low maintenance dependability is built into every S-A belt conveyor. Convey with S-A . . . the Equipment that's designed and built by the men who know conveying best . . . STEPHENS-ADAMSON.

S-A ENGINEERED PRODUCTS FOR BULK HANDLING



S-A BELT CONVEYORS—REQUEST CATALOG DATA

S-A AMSCO FEEDERS—BULLETIN 255



S-A TUNNEL GATES—REQUEST CATALOG DATA

WRITE FOR LITERATURE LISTED

S-A

ENGINEERED BULK HANDLING SYSTEMS
MATERIALS HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
SEALMASTER® BALL BEARING UNITS
SPHERCO® BEARINGS & ROD ENDS

ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 66 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

"'Live track' power steering rock...SO WE KEEP OUR TD-25

—Asheville Contracting Company,

Shale and blue granite rock make up 85% of the 550,000-cu. yd. of roadway excavation on this contract —5.18 miles of Blue Ridge Parkway construction, for the United States Department of Interior.

That's why Asheville Contracting Company places maximum reliance on their "rock-movers' special": king-sized International crawler power! Where the going's too tough or job progress is too slow and costly with big clutch-steered crawlers, "Asheville's" new 230-hp TD-25 and two veteran TD-24's take over—and "run interference."

"International 'live track' power steering moves more dirt and rock," states M. H. Reighard, Superintendent of rock operations for "Asheville." "Therefore, we keep our TD-25 and TD-24's on trail-blazing and pioneering. The 'live track' feature keeps the blade in the material and makes steep work safer. TD-25 balance enables working 'almost straight up' on mountainous terrain."

Exclusive, years'-proved International Planet Power-steering gives you full-time live power on both tracks to handle full loads on turns as well as straightaways. Load-limiting "dead-track drag" is eliminated. And

moves more PIONEERING"

Asheville, No. Carolina

"live track" power-steering is combined with on-the-go, Hi-Lo power-shifting that lets you match power to load instantly, for full-speed cycles. You do away with time-wasting "gear-shift lag!"

New TD-25 seven-roller tracks are strength-matched to the full effort of the high-torque, 230-hp turbo-charged Diesel engine! The "25" is platformed on shock-resistant, double-box-beam track frames—smoothly carried on International's dual-protected Dura-Rollers, the track rollers that make 1,000-hr. lube intervals practical!

As standard equipment at no extra cost, the TD-25 gives you exclusive, combined Planet Power-steering and Hi-Lo on-the-go power-shifting. And you get this work-speeding design advantage in torque-converter or direct drive model. Here, Asheville's "25" operator is ready to "shift-up" to keep the load on the move.

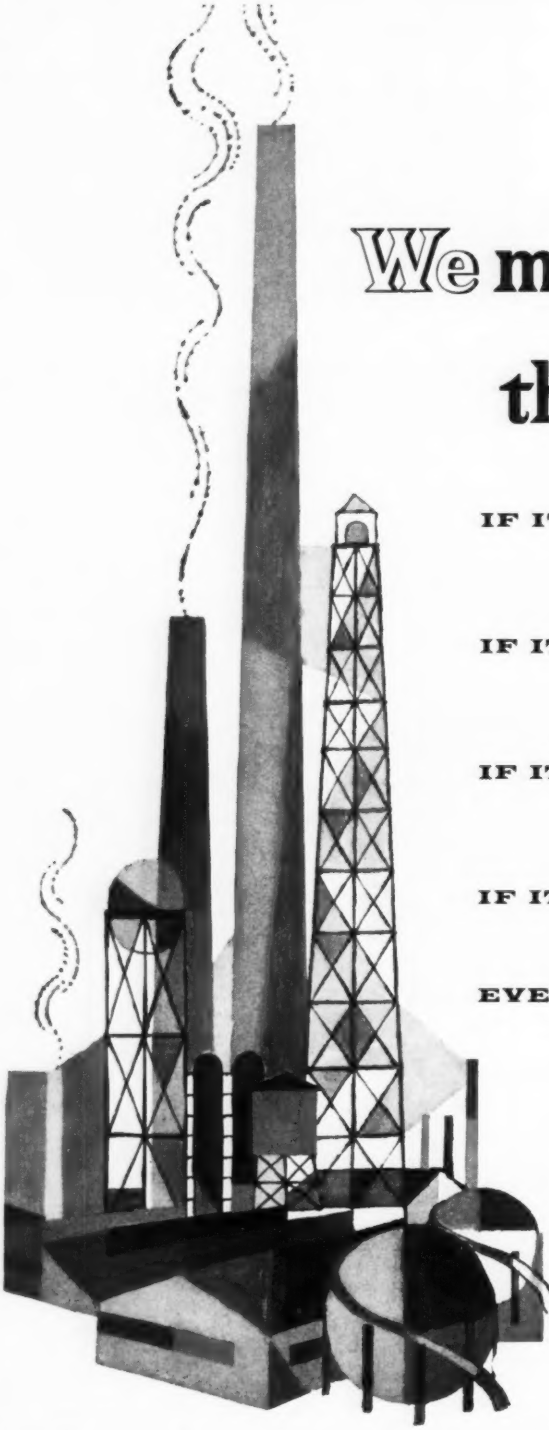
Power-steer and power-shift the TD-25 with king-sized loads—around curves, upgrade, anywhere! Compare planet-powered "25" ability to deliver full-load capacity, full-time—to outearn other big rigs up to 50%—blading rock, benching, push-loading, mass-production dozing (where fast reverse and decelerator action count), ripping shale! Let your International Construction Equipment Distributor demonstrate!

Even with an enormous offset load of shot-rock there's no "bank-nosing;" no sluing. The TD-25 operator simply operates the load-side track in high-speed range—the other track in low-speed range. Result: full-capacity, straight-ahead performance—the same as the "25" gives on benching, bank-cutting, or side-casting!

Here's your 76-page cost and production estimating book—newest, most authentic and complete guide for estimating material-moving costs—and for selecting equipment combinations for top profits, ***anywhere!*** **Yours for the asking from your International Construction Equipment Distributor!**

International® Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.
A COMPLETE POWER PACKAGE



We make the pumps that move it !

IF IT FLOWS... through pipelines, heat exchangers, cooling towers, evaporators, condensers, stills, boilers or other processing equipment . . .

IF IT'S LIQUID... gases, paints, molasses, lubricants, chemicals, foods, plant wastes, asphalt, fuel oils, solvents, fibrous trash or solids in slurries . . .

IF IT CIRCULATES... through cracking plants, refineries, canneries, paper mills, steel mills, packing plants, breweries, air conditioning systems or machine tools . . .

IF IT'S PUMPED... in or out of mines, sewers, construction sites, cofferdams, swamps, reservoirs or tank cars . . .

EVEN IF it's highly corrosive or volatile, viscous or non-viscous, hot or cold . . .

The Fairbanks, Morse line of pumps includes a type, size and capacity for almost any pumping requirement—and the power unit matched to drive it!

Pump sizes to 152 inches . . . capacities to 800,000 gpm . . . heads to 3000 psi.

(Electric motors that move the pumps: ½ to 10,000 hp... Generators, alternators and generator sets ½ kw to 3,500 kva.)

Fairbanks, Morse

PUMP AND HYDRAULIC DIVISION • KANSAS CITY, KANSAS

A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION, NEW YORK

Keep our roads on the GO

Mr. Herschel H. Allen, Senior Partner of the J. E. Greiner Company, Edward J. Donnelly, and John J. Jenkins, Jr., partners. Some of their outstanding bridges that won coveted awards include the Delaware River Bridge, Trenton, N. J. to Morrisville, Pa.; Cuyahoga River Bridge, Ohio Turnpike; Susquehanna River Bridge, Havre de Grace, Md.

Interchange of U. S. routes 50 and 301 with Maryland route 2 near Annapolis, Maryland.

Steel specified in over 1,000 bridge designs

WILL PERFORM FOR A CENTURY WITH A RIVER ON ITS BACK

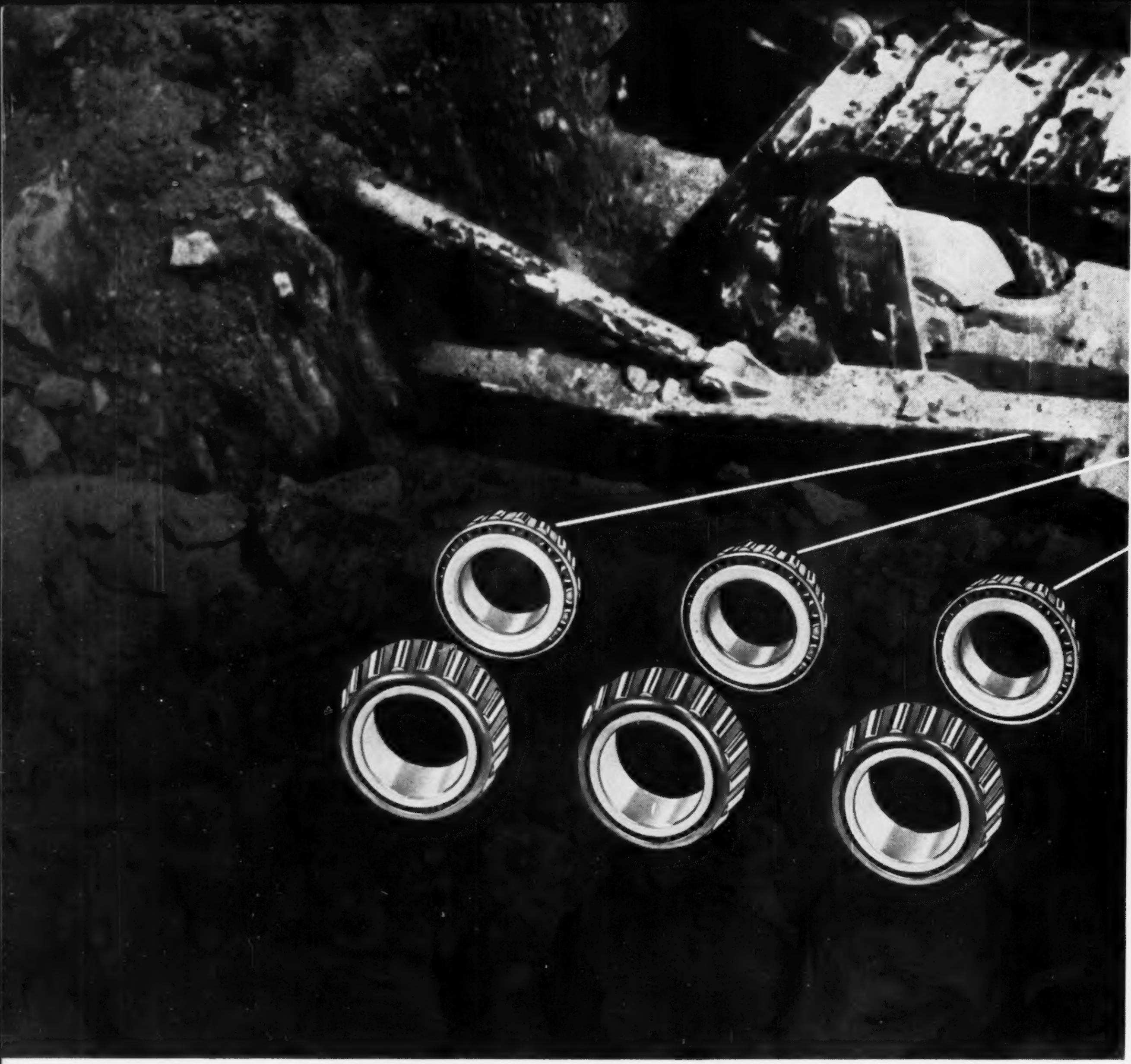
At left, you see a length of cast iron pipe being installed under the Floyd River in Iowa. This is part of a water feeder main which will reinforce the existing water supply system.

Despite the severe conditions of a river overhead, the inherent ruggedness of cast iron pipe promises at least a century of trouble-free performance, and rarely requires repairs or replacement.

And cast iron pipe's cement lining assures a continued full flow of water year after year. It's no wonder that more than 90% of the pipe used for water supply systems in our 50 largest cities is cast iron pipe!

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE



MORE WORK POWER

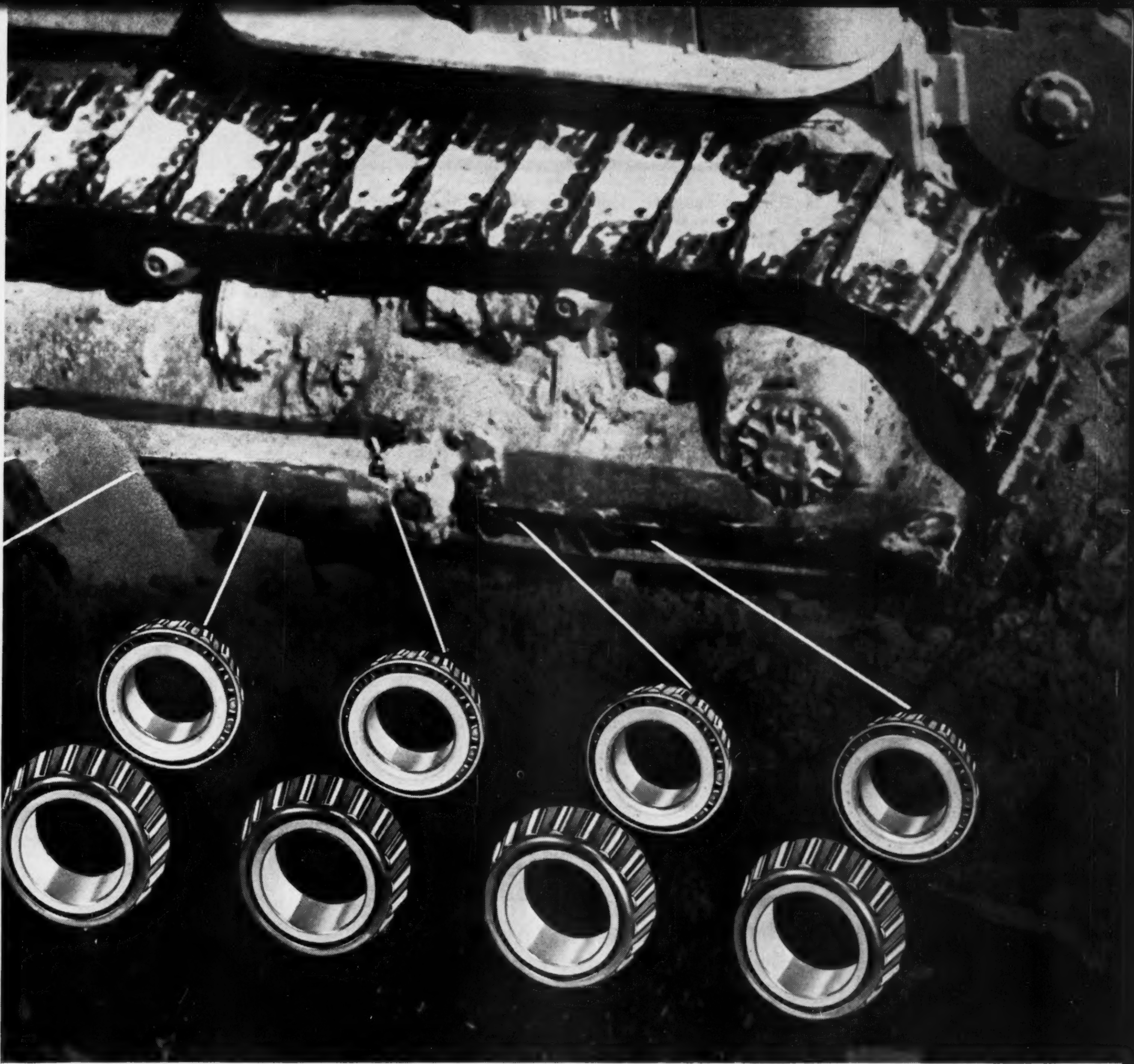
Reduced friction through use of tapered roller bearings in all Allis-Chalmers crawler tractors makes the difference in work power and profit for you!

All Allis-Chalmers crawler tractors roll on tapered roller bearing truck wheels. Most others still use bushings.

Anyone who remembers his roller skating days knows the performance advantages of bearings over bushings. The difference between first and also-ran was in the wheel bearing. This friction-reducing advantage is the reason railroads all over the country have turned to *roller* freight.

The same principle applies to tractors except much more power is being wasted by friction-type plain bushings. It's one of the reasons the 225-hp HD-21, on tapered roller bearings, produces right alongside the biggest tractors you can buy. Can you

move ahead with



NEWS OF MEMBERS

Gordon L. Williams has left the Harza Engineering Company, Chicago, after a six-year association to become project engineer for the Development and Resources Corporation of New York on the construction of Dez Dam in Iran. While with Harza Engineering, Mr. Williams served for four years as head of the Specification and Estimating Department and for two years as resident engineer on the construction of several large dams in Asia.

Nicholas Chryssafopoulos, for the past three years assistant professor of civil engineering at the University of Illinois, has resigned to become a member of Woodward-Clyde-Sherard and Associates in their Greer Engineering Division at Montclair, N. J.

F. Carlyle Roberts, Jr., of the U.S. Public Health Service, left Washington recently on a two-month health-program observation trip to Brazil, Peru, Guatemala and Mexico, under the aegis of the World Health Organization. In his capacity as a training officer in the International Education and Exchange Branch, Mr. Roberts arranges programs for foreigners who come to the United States for advanced education in environmental sanitation.

C. N. Harrub, an engineer for 57 years, retired recently to Fort Myers, Fla. A consulting engineer for the past 36 years with offices in Nashville, Tenn., Mr. Harrub served in his earlier career as sanitary engineer with the U. S. Public Health Service and as director of the Division of Sanitary Engineering in the Tennessee State Department of Public Health.

Aavo Merend has joined the staff of the Knolls Atomic Power Laboratory, Schenectady, N. Y., as an engineer engaged in the mechanical design of nuclear cores for the D1G Project which is developing twin reactors for the Navy's first nuclear-powered destroyer-class ship, *Bainbridge*. The Laboratory is operated by the General Electric Company for the Atomic Energy Commission.

George M. Foster, executive director of the Indiana State Highway Department, was elected vice-president of the American Road Builders Association at the organization's recent 58th annual convention. **John P. Moss,** president of the Moss-Thornton Construction Company, and **W. A. Bugge,** director of highways, Washington Department of Highways, were reelected vice-presidents, while **J. N. Robertson,** former District of Columbia highway director, was reelected treasurer. **George S. Richardson,** partner in the Pittsburgh, Pa., consulting firm of George S. Richardson & Associates, was elected president of the association's Engineering Division, and **J. Stephen Watkins,** consulting engineer of Lexington, Ky., was elected division vice-president. New directors are **Guy Kelcey,** of Edwards and Kelcey, Inc.; **Earle V. Miller,** of Johannessen, Girand & Miller; and **Murray A. Wilson,** of Wilson & Company.

Wayman G. Wing, former associate of Seelye, Stevenson, Value & Knecht, has opened a consulting engineering office at 411 Seventh Avenue, New York City. During his twelve years with the firm, Mr. Wing was in charge of the structural design and field inspection of the Statler-Hilton Hotels in Dallas, Tex., and Hartford, Conn., and of other major buildings throughout the United States.

Victor W. Anckaitis, of the Alpha Portland Cement Company, at Easton, Pa., has been promoted to the post of director of property management. Mr. Anckaitis has been with Alpha since 1951 when he joined the firm as a construction engineer.

A. F. Garlinghouse received a Certificate of Merit from the U. S. Chamber of Commerce at a recent two-day National Construction Industry Conference held in Washington, D. C. One of the founding partners of Garlinghouse Brothers Company, Gar-Bro Manufacturing Company and chairman of the board of Garlinghouse, Fremon & Company, all of Los Angeles, Calif., Mr. Garlinghouse received a similar honor from the Beavers in 1957.

B. A. Vallerga has joined the Golden Bear Oil Company as director of Products Engineering at its new laboratory near Bakersfield, Calif. For the past seven years Mr. Vallerga has been managing engineer of the Asphalt Institute for the Pacific Coast Division with headquarters at Berkeley, Calif. Succeeding him is **Vaughn Marker,** a member of the Institute since 1955, and division paving engineer since 1958.

B. A. Vallerga

Vaughn Marker

Winfield Givens retired recently as manager of the Sun Oil Company's Land Department after 40 years of service. During his career Mr. Givens helped pioneer production operations in Venezuela and Canada, and rose to become, in addition to his position as head of the Land Department, a director and executive vice-president of Sun's eight foreign production subsidiaries and an officer in two other Sun subsidiaries.

Arthur R. Robinson is scheduled to join the engineering faculty at the University of Illinois in September 1960. Dr. Robinson, who has been at the University of Minnesota, will be an associate professor of civil engineering.

William W. Sullivan has resigned as special assistant for engineering affairs to the Deputy Postmaster General of the United States to become program control officer at the Emerson Research Laboratories, Silver Spring, Md., a division of the Emerson Radio and Phonograph Corporation. In his new capacity, Mr. Sullivan will have charge of status reporting, manpower control, budgeting, and related program controls in the company's research and development projects.

Richard B. Tanner, currently a senior at Sacramento State College (California), has accepted a graduate fellowship to study structural engineering and mechanics for three years at the Agricultural and Mechanical College of Texas, effective September 1960. The fellowship is under the sponsorship of the National Defense Education Act.

Houssam M. Karara received the second prize of the 1959 Talbert Abrams Award at the 26th Annual Meeting of the American Society of Photogrammetry for his paper on "The Character of Errors in Spatial Aerotriangulation." The paper outlined a research project Dr. Karara is now pursuing under the sponsorship of the Research Board of the University of Illinois, where he is assistant professor of civil engineering.

Charles W. Cook has been promoted to test engineer in the Operating Department of the United Illuminating Company. His new duties include responsibility for programming, scheduling, and analyzing the testing of the firm's power generating equipment for operating efficiency and maintenance purposes.

George F. Wyllie, after 20 years as superintendent of sewage treatment at Lansing, Mich., recently became Lansing city engineer. Earlier he had been associated with McNamee, Porter and Seeley, Ann Arbor consulting engineers.

Iredell W. Peters, for thirteen years sales engineer and sales manager with the Tennessee Metal Culvert Company, Nashville, has been appointed managing director of the Corrugated Metal Pipe Association of Tennessee.

Robert B. Diemer is one of four recipients of 1960 Missouri Honor Awards for Distinguished Service in Engineering, presented by the University of Missouri. The citation recognized Mr. Diemer for "his outstanding achievement in the development of irrigation in the United States and Mexico" and for "his engineering skill and foresight in directing the location, design and construction of the Colorado River Aqueduct"—named by ASCE as one of the Seven Engineering Wonders of the United States. It was under Mr. Diemer's direction as general manager and chief engineer of the Metropolitan Water District of Southern California that the $200 million expansion program to bring the Aqueduct to its full capacity was undertaken.

Thorndike Saville, Jr., recently received the annual award as "Outstanding Young Engineer" from the District of Columbia Council of Engineering and Architectural Societies and the Washington Academy of Sciences. Mr. Saville is currently chairman of the Committee on Coastal Engineering of the Waterways Division of the Society, and assistant chief of the Research Division of the Beach Erosion Board, Corps of Engineers, U.S. Army.

(Continued on page 26)

C. L. Leonard has been advanced to the newly created post of assistant construction engineer for the California Electric Power Company. He first became associated with Calectric in 1954 as a junior civil engineer, becoming construction schedule engineer in 1956, his most recent post.

David G. Chase, until recently secretary-manager of the Clay Pipe Institute, Los Angeles district, has been made director-sanitary engineering at the Texas Vitrified Pipe Company, with headquarters at Fort Worth. As project engineer for the Willard-Brent Company in Los Angeles and district engineer for the Rocky Mountain Area of the Clay Products Association, he has wide experience in the sanitary engineering, construction and materials handling fields.

W. J. Dennis, assistant district engineer of the New York State Department of Public Works at Hornell, has been promoted to district engineer. Mr. Dennis has been a member of the Department of Public Works since 1926, and assistant district engineer since 1954.

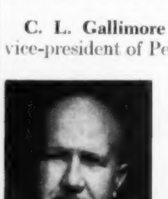
Donald A. Giampaoli has been added to the staff of the National Concrete Masonry Association as associate design engineer in the Washington, D. C., office. Previously, he was an engineer with the District of Columbia.

Alfred C. Leonard, for several years an associate in Malcolm Pirnie Engineers, of New York City, has joined the partnership. Before being named an associate, Mr. Leonard was an engineer with the firm.

Fred K. Woolley has been transferred from Fresno, Calif., to Seattle, Wash., as manager of the Seattle Concrete Conduit Company, a division of the American-Marietta Company. Before becoming manager a few years ago, Mr. Woolley was construction engineer in the Fresno office.

Paul D. Troxler, Colonel, district engineer for the Army Corps of Engineers at Jacksonville, Fla., will retire from active duty July 31 after more than 30 years of service. Colonel Troxler assumed the Jacksonville assignment after several years as district engineer for the Middle East District with headquarters at Tripoli, Lybia, and as a member of the staff of the assistant chief of engineers for military construction in charge of engineering and contracts.

C. L. Gallimore was recently elected vice-president of Peter Kiewit Sons' Company. Before joining the organization in 1946, he spent 17 years with the Corps of Engineers in the Ohio River Valley engaged in the planning and construction of numerous navigation, flood control, and wartime construction projects.



Brian J. Lewis, formerly traffic and transportation engineer in charge of the Seattle office of Porter, Urquhart, McCreary & O'Brien, recently joined Whipple, Murphy, Pearson & Associates, Palo Alto, Calif., as a partner. In his new position he will specialize in the firm's work in fields of traffic, highways, planning and feasibility studies and will also be in charge of an office at 403 Alaska Trade Building, Seattle, Wash.

Henrik Ring announces the opening of offices for design and consulting engineering at 19650 Ventura Blvd., Tarzana, Calif. He was formerly affiliated with C. F. Braun and Company, Rocketdyne, and the Ralph M. Parsons Company.

John R. Kemp has been appointed civil engineer with the Lindsey Engineering Company, of Minneapolis, Minn. Mr. Kemp, a 1955 graduate of the University of Iowa, was formerly employed by the Minnesota Department of Highways.

Arthur P. Geuss, since 1946 a member of the Harza Engineering Company, Chicago, was recently elected a director of the company. He is also vice-president and chief engineer of Harza. Mr. Geuss was previously assistant to the chief engineer of Erik Floor and Associates.

Van Court M. Hare was recently elected a director of Chas. T. Main, Inc., consulting engineers of Boston, Mass., and Charlotte, N. C. Mr. Hare, who has been associated with the firm since 1954—primarily in the hydroelectric field—is currently engaged through the Chas. T. Main, Inc., affiliated partnership, Uhl, Hall & Rich, on the Niagara and St. Lawrence Power Projects in New York State.

Robert E. Meyer resigned in March from the Tektronix Employees Retirement Trust to open a consulting engineering office at 22 Watson Street, Beaverton, Ore. His consulting services will encompass civil, sanitary, municipal, and land development engineering.

William G. Weaver, Jr., for the past three years a member of the Greater Hartford (Conn.) Flood Commission, has been named Hartford's deputy director of public works. In the past he has served with the Bureau of Public Works of the Metropolitan District, as director of the New Canaan Sanitary Commission, and maintained a consulting practice.

William R. Gianelli has left the California Department of Water Resources, where he was district engineer in the Los Angeles office, to enter private engineering consulting work in the Sacramento area. Mr. Gianelli as a full partner in Bookman & Edmonston, whose main offices are in Glendale, brings to his work 14 years of experience in state service.

(Continued on page 28)

Joseph E. Hardee has joined the Asheboro, N. C., consulting engineering firm of Moore, Gardner and Associates, Inc., as an associate engineer and secretary of the firm. Previously he was assistant professor in the Engineering Mechanics Department at North Carolina State College in Raleigh and engaged in private practice.

Steven Galezewski was elected a vice-president of the Rockwin Prestressed Concrete Corporation, Santa Fe Springs, Calif., at a recent meeting of its board of directors. A "pioneer" in the use of prestressed concrete in this country, Mr. Galezewski has been associated with Rockwin since its establishment, most recently as chief engineer.

Max A. Krasnick, former general manager of Exportada de Sal, with headquarters at Black Warrior Lagoon, Baja California Sur Mexico, has been appointed exclusive distributor of Switzer Panel Products for building construction in San Diego County. Mr. Krasnick will have his offices in San Diego, Calif.

Bertram S. Warshaw announces the removal of his offices for the practice of structural and civil engineering from 4361 Mayfair Drive, Miami, Fla., to 255 University Drive, Coral Gables.

Thomas E. Maxson, since 1928 assistant city engineer of Memphis, Tenn., has been appointed to the newly created post of principal civil engineer in the Memphis Department of Public Works. Mr. Maxson will serve directly under the city engineer.

Harold A. Vicker, chief engineer and since 1948 vice president of the Scranton (Pa.) Division of the Scranton-Spring Brook Water Service Company, has been named chief engineer of water operations for both the Spring Brook Division and the Scranton Division.

Alfred C. Klahre has left the Hawaii Highway Department, Honolulu, where he has been project engineer since 1956, to become staff engineer for the Hawaii Aeronautics Commission, with headquarters in the same city.

Vaughan M. Daggett has been appointed to the Planning and Design Policies Committee of the American Association of State Highway Officials. Employed by the Maine State Highway Commission in 1928, Mr. Daggett became chief engineer of the Commission in 1955.

E. J. Woodward, Jr., formerly chief engineer of Industrial Asphalt, and most recently an executive with the Kenneth H. Golden Company, of San Diego, has returned to Industrial Asphalt of California, Inc., as vice-president. His duties include liaison between technical committees in the asphalt paving materials field, public relations, and development of new plant locations and marketing areas.

. . . . . Am-Soc Briefs

▶ ▶ Let's get the job done by June! This is the rallying cry these final (we hope) days in the drive for funds for the United Engineering Center. To make it effective, the 42 Local Sections that are still at varying distances from their goals must put into their campaigns that final spurt of energy needed for victory. The remaining 8 per cent of ASCE's quota can be written off in June only by accelerating the drive. . . . The campaign for funds must continue into the summer, of course, if the June target date isn't met.

▶ ▶ With water the nation's No. 1 problem, the Reno Convention program will appropriately feature engineering aspects of water matters. The U. S. Committee on Large Dams and several of the Technical Divisions are teaming up for joint sessions on problems related to dams and for a field trip to the Upper American River Project. The entire Convention program appears elsewhere in this issue.

▶ ▶ The grass roots speak! Sensitive to the will of the membership, the Society has acted to modify the controversial policy statement relating to public and private engineering services in government. See page 82.

▶ ▶ Win friends for the profession. . . . To advance public understanding and appreciation of civil engineers and their work requires a sound public relations program. For local use of ASCE public relations committees the Society's Public Relations Department has prepared a helpful "Public Relations Guide." Copies have been sent to the Sections. Other members needing copies for ASCE work may write Public Relations Director M. O. Chenoweth at ASCE Headquarters.

▶ ▶ Career guidance. . . . Very much to the point in the all-important matter of career guidance is "The President's Column" in the April issue of the San Francisco Section's monthly publication, "The Civil Engineer." Section President John Blume writes of his response to an eighth grade student in a country school who had written asking how to prepare himself for a career in civil engineering. Mr. Blume's concrete and helpful suggestions included an invitation to visit his office and get an idea of the civil engineer's life for himself. Here is an idea for other consultants. . . . In the past six months, incidentally, Society Headquarters has answered 2,556 requests for information on civil engineering as a career —from high school students, teachers, and concerned parents.

▶ ▶ This month, for the first time, ASCE membership has gone over the 45,000 mark. Last year at this time the membership stood at 42,574, and in 1930 (the year "Civil Engineering" started) it was 14,218.

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do you know that

The U.S. is one of more than fifty nations conducting censuses this year? Of these the U.S. has maintained the longest continuing series of periodic counts—every ten years since 1790. The number counted in the current census is expected to be about forty-five times the number counted in 1790—180 million as against 3.9 million. Although our population has increased by nearly 30 million in the past decade, the population density is expected to remain at about the 1950 level—50 persons to the square mile. The reason for the apparent standstill is the addition of vast Alaska with its sparse population.

■ ■ ■

Highway construction costs have risen less than 3 percent above their 1953 level? In fact, they are at the lowest point in the past three years, according to a spokesman for the Associated General Contractors of America in recent testimony before the House Committee on Public Works. With 1953 as the base year, contractors' bid prices have increased only 2.7 percent, while average employee earnings have advanced 33.4 percent and material costs 20.2 percent. Keen competition among highway contractors and efficient use of improved equipment are seen as the reasons.

■ ■ ■

Record imports of foreign steel flooded into the U.S. in 1959? Foreign steel imports were over 150 percent greater than in 1958—an increase of 2.4 million tons. A change in the pattern of shipments, with an increase of 485 percent in shipments admitted through Great Lakes ports, is regarded as a direct result of the opening of the St. Lawrence Seaway.

■ ■ ■

The surface of the moon is under study? This year the U.S. Geological Survey will complete a terrain study of the surface of the moon, which is expected to prove invaluable in the selection of a landing site. The terrain study will also help in determining how to build on the moon and in solving other space exploration problems.

■ ■ ■

If all the tides could be harnessed, they could produce 2 billion horsepower annually—about half the world's needs? However, conditions for using the tides have to be just right, and there are only a few potential tidal power sites on earth. In addition to our own Bay of Fundy (under joint study by the U.S. and Canada), these sites are the Brittany coast of France around St. Malo; the Severn estuary on the east cost of England; Penzlinskava Bay in Siberia; Cook Inlet, Alaska; and the San Jose and Decada Rivers in Argentina. Our thanks for this item to an article by Dr. C. P. Idyll in the April issue of *Science Digest*.

■ ■ ■

Brazil is moving into its new capital? On April 21 Brazilia —a metropolis created by four years of round-the-clock work—became the official seat of the Brazilian Government. The beautiful city of concrete and glass represents the last word in urban planning. Each group of buildings forms a neighborhood unit, with its own shopping center, schools, and other facilities. In the entire city there are no intersections at grade level—only underpasses and overpasses, viaducts and cloverleaves.

■ ■ ■

Engineering enrollment has dropped for the second consecutive year? Figures compiled by the American Society for Engineering Education and the U.S. Office of Education show that the total undergraduate engineering enrollment in 1959 was 240,063—in comparison with enrollments of 249,950 in 1958 and 257,777 in 1957. In 1959 there were 33,695 engineering graduates. Civil engineering was in third place with 4,939 graduates. There were 9,837 electrical engineering graduates and 8,300 graduates in mechanical engineering.

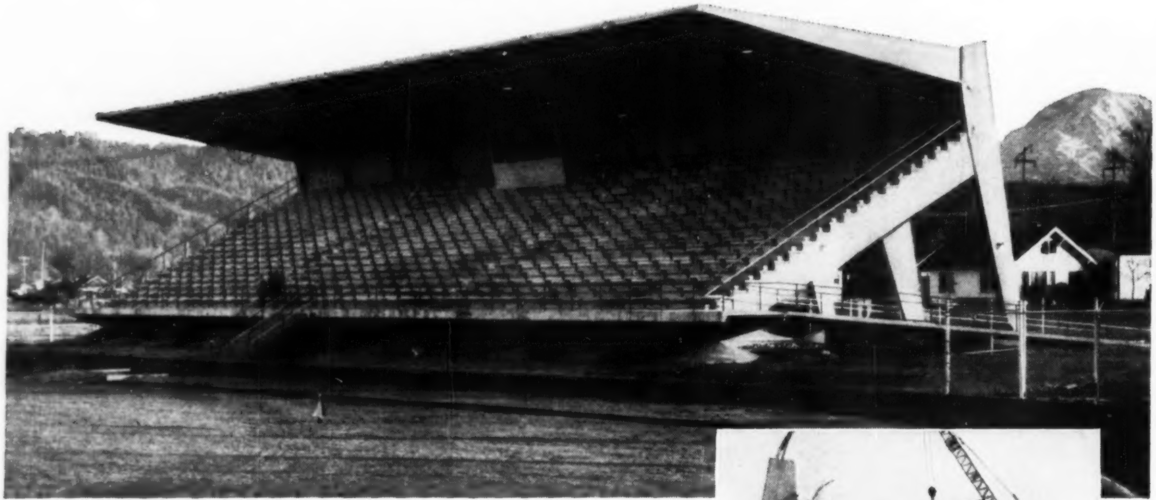
■ ■ ■

The U.S. system of weights and measures threatens our position in world economy? This stand was taken by Dr. Edward Teller, famous physicist and father of the hydrogen bomb, in a recent talk urging adoption of the metric system. Use of the system has been recommended by such historical figures as John Quincy Adams. ASCE first approved the idea in 1878. The advantages of the system will be discussed in an early Civil Engineering article.

■ ■ ■

An unusual bridge will soon be built across the Ohio? However, it will not be as unusual as we made out in the April issue (page 111). Civil Engineering stretched the proposed bridge between New Albany, Ind., and Louisville, Ky., an additional 80 miles to Lexington, making it one of the longest bridges or biggest bloopers of the year.

Grandstand Play! *NO VIEW-OBSTRUCTING PILLARS IN PRESTRESSED CONCRETE STADIUM*



● Spartan Stadium is an example of what can be accomplished with modern methods and the most modern of structural materials—prestressed concrete. And once again, Incor®—America's *first* high early strength portland cement—was voted "most valuable player."

The structure was assembled from precast, prestressed concrete units, drawn together by high-tensile-strength cable. Its slender appearance belies its ability to withstand earthquakes, 87-mph winds and as much as 95 tons of snow.

The structural frame was composed of eleven "F"-shaped units, each consisting of a slanted "backbone" column, a saw-toothed diagonal seat-supporting beam, and a cantilevered roof beam. All of these members were precast and prestressed—pre-tensioned on casting beds, and post-tensioned in assembly. Erected by crane, they were joined together with steel cables which were tensioned by hydraulic jacks to forces as high as 200 tons.

Seats were formed of prestressed L-shaped units placed on the saw-toothed members, and the roof consists of thin prestressed slabs resting on cantilevered beams.

(Above) Saw-toothed inclined beam supports prestressed seats. After roof assembly, columns were post-tensioned to take bending stress introduced by the cantilever. (Below) With soft underlying mud limiting foundation soil pressure to 500 psf, shell concrete footings were used over gravel to distribute load.

SPARTAN STADIUM
Sumner High School, Sumner, Wash.
Architects:
LEA, PEARSON & RICHARDS
Engineers:
ANDERSON, BIRKELAND & ANDERSON

General Contractor:
CONCRETE CONSTRUCTION COMPANY
Precast Units Fabricated by:
CONCRETE TECHNOLOGY CORPORATION
(All of Tacoma, Wash.)

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Transmission-line construction by helicopter

FREDERICK R. PAYNE, Jr., Brig. Gen., USMC (Retired), Administrator
Aircraft Operations, Southern California Edison Company, Los Angeles, Calif.

Use of rotary-winged aircraft for transmission-line construction in difficult terrain has permitted substantial savings on certain Southern California Edison Company jobs. On one pole line, savings were estimated at 47 percent. These projects were undertaken by the utility as feasibility studies to determine what role such aircraft as helicopters might play in transmission-line and other construction.

There is a great need for improvement in rotary-winged aircraft for use on construction—in such things as greater lifting capacity, better arrangement for handling loads and the like. More powerful turbine-type aircraft are being developed. These will permit the handling of heavier loads with greater safety. Designing foundations, towers and other parts of the lines so that less weight and fewer pieces will be required in inaccessible areas will aid aircraft to do even more in transmission-line erection.

The helicopter is an awkward-looking aircraft whose only attribute is a versatility unmatched by any other means of transportation. The machine is expensive to operate; it has a high maintenance to availability ratio; and its performance is greatly affected by extremes of temperature and altitude. High winds or extremely low visibility materially affect its availability for use. For example, out of 60 operating days available on a recent job, 5 were missed because of high winds.

Several factors contribute to the economics of use of rotary-winged aircraft for a particular job: owner or contract operation of the aircraft; accessibility of the line to other means of construction; cost of access right-of-way through valuable property; time and cost of easements and litigation; and the expense of building roads in rocky and rugged terrain for surface access. The helicopter does not solve these problems; it can alleviate some of them. A few recent jobs indicate how the rotary-winged aircraft is currently used.

Tower construction

Fifteen towers were scheduled to be placed by air lift on a particularly rugged five-mile section of the Saugus-Santa Clara 220-kv line. All phases of the tower construction could be accomplished by helicopter except the moving in of the 10,000-lb conductor reels and the pull-through and sagging of the conductor. Tensioning and pulling equipment could be supplied for easy knockdown and reassembly after air lift.

Two helicopters were available—one of heavy type, which could lift a 1¾-ton load, and one of light type which could lift a ¼-ton load. Table I shows how the job was planned for the best use of the equipment available. It also gives helicopter time, cost, and suggested changes in methods for similar future construction.

What the helicopters did

A base camp and an assembly yard were established at the foot of the mountain at a location accessible by road. A platform was carried by the helicopter to the tower site and leveled by men on the ground and then a concrete hopper was set on it. Transit-mix trucks brought concrete to the yard, discharging into ½-cu yd buckets. The helicopter moved this to the tower base, where it was dumped, through the hopper and chutes, to the tower foundation. In eleven days of flying, 462 tons of concrete was transported for the foundations for 15 towers. The cost per cubic yard was $79.20 and the cost per ton, $39.60.

Immediately following completion of the tower foundations, steel was car-

Heavy-duty helicopter hovers as ground crew releases a load of concrete from its ½-cu yd bucket into a hopper at transmission tower.

Heavy helicopter helps in the erection of a gin pole for use in placing tower steel for the Edison Company's second Saugus-Mesa transmission line.

A light helicopter drapes the "fly line" over a transmission tower in preparation for the stringing of the conductor for 220,000-v second Saugus-Mesa line.

TABLE I. Tower construction project by helicopter

(15 towers, 4 footings per tower)

Operation	Helicopter	Hours	Cost per Hr	Total Cost	Cost per Tower
Tower location, site preparation, excavation, personnel transport	Light type, ¼-ton	182⅓	$68	$12,398	$824
Recommended changes: Use of lighter compressors, new explosive techniques for excavation, field phones for communication in rough terrain, improved air-ground communication. Possible saving per tower is estimated at $324.					
Placing concrete, with average round trip of 3.3 miles:	Heavy type, 1¾-ton				(Cost per cu yd, $79.20; cost per ton, for 462 tons, $39.60)
Transport of concrete, 231 cu yd, 462 tons	Heavy type	55			
Transport of hopper, table, chutes	Heavy type	5			
Transport of air compressor, cages	Heavy type	1			
Totals		61	$300	$18,300	$1,220
Recommended changes: Possible use of lighter bucket with a 15 percent saving in delivery cost, improved handling of hopper and associated gear, and improved planning through experience. The possible saving per tower by these improvements is estimated at $420.					
Tower erection; total weight of steel, 112 tons:	Heavy type				(Cost per ton of steel, $106)
Transport of steel, personnel, insulators, hoists, gin poles, etc.	Heavy type	39 hr 46 min	....	$11,930	$800
Transport of personnel, tools, material	Light type	93 hr 4 min	....	$ 7,647	$509
Recommended changes: Careful coordination of helicopters and better planning. Possible saving per tower is estimated at $109.					
Stringing the fly line, 30.5 miles	By conventional methods	....	....	$ 680	....
Recommended changes: Use of new type of dispenser. Estimated saving would be $230 per tower.					
Pull-in and sag conductor	By conv. methods & light-type helicopter				
Installation of armor rod, clip conductor, B & B guards, signs, clean-up	Light type				

ried to the sites in bundles weighing up to 3,000 lb each. The bundles were set down in marked areas, followed by cargo nets containing insulators, nuts, bolts and attendant equipment. It frequently was essential that everything required to build the tower be placed on the site before construction started, as some sites did not have a large enough level area for the helicopter to land, once tower erection had started.

Steel workers were transported to the site in the larger helicopter, along with a gin pole in sections, and a power winch for lifting. The gin pole was assembled, with the helicopter lifting the apex of the pole to an upright position. After the tower was completed, the initial fly line for the conductor pull-through was flown in by the light helicopter.

Pole installation

Pole installation by helicopter is now a routine technique. Savings are of course proportional to the inaccessibility of the sites. Helicopters available for commercial use can handle poles up to 65 ft long, with all attachments in place. The framing yard for such an operation must be readily accessible to the pole trucks and must have enough room to frame the poles with cross arms, insulators, guy wires, anchors and the like. A yard meeting these requirements, and close to the center of the line, will aid materially in cutting the cost of placing poles.

For one project, three framing areas were established at convenient loca-

:ions on the road, and in these areas 43 poles were completely prepared. Final weights varied from 1,200 to 1,600 lb each. The top side of a cross arm on each pole was clearly numbered in relation to the hole in which it was to be placed.

The most effective lifting point of a helicopter is about 12 ft off the ground. A 1-in. manila rope sling, with a metal clevis ring, was attached just below the cross arms of the poles so that the poles started rising about 7 ft from the helicopter hook.

Configuration of helicopters now available is such that neither the pilot nor the co-pilot can see directly beneath. One crew man with intercom helmet and safety harness must be in the cargo section to give the pilot accurate spotting directions. When the machine is hovering near the ground the rotor stirs up a heavy dust and creates a static electricity problem. Static dissipators on poles, goggles, protective gloves and proper clothing will provide protection for the ground crew.

On this job two men were assigned to the framing area to connect the pole slings to the helicopter, four men (one to each of the four holes) to guide the poles into place. Two others, with transportation and radio communication equipment, moved crewmen ahead as the work progressed.

The helicopter hovered over the pole yard while the sling was connected, then raised the framed pole a couple of hundred feet suspended vertically, and transported it to the assigned location. The helicopter hovered again and by direction moved slowly till the pole was within one foot of the ground. The ground man guided the pole into the hole; when the sling slackened the helicopter moved laterally so that the pole would lean uphill.

A very accurate record of flying time was maintained by the helicopter crew. In the first hour fifteen 40-ft poles were transported and set on a section of line about 1½ miles long.

The economies realized on this particular job were good. The estimated cost of transporting and setting the poles by conventional methods, using bulldozers, a tractor-mounted hole digger and the necessary crew was $4-140. Using a helicopter, the cost was $2,167, a saving of $1,973, about 47 percent. For this particular job the helicopter cost was $34.80 per pole. About 476 man-hours were saved. Recently, 108 poles for a radar installation were transported and placed in the rugged Santa Ana mountains. Six poles per hour were transported over a six-mile run and set at an average cost of $70 per pole.

The development of the helicopter has progressed rapidly compared with its fixed-wing counterpart, but the present large passenger types are entirely unsuitable as a routine piece of construction equipment. The advent of the turbine power plant will produce dramatic improvements in the performance of rotary-wing aircraft. It represents a major break-through in the reduction of operating costs and requires new planning for commercial operation. Some of its outstanding advantages are:

1. A weight of less than half that of a reciprocating engine of comparable power.
2. Freedom from vibration since all motion is rotary and smooth and the combustion process is continuous rather than intermittent.
3. Reduced noise. The noise level of a 250-hp reciprocating engine and that of an 859-hp turbine engine are about the same. In other words, about three times the power can be utilized without significantly increasing the noise.
4. Relatively minor cooling requirements.
5. Reduced maintenance because of simplicity and freedom from vibration.
6. More operation hours between overhauls.
7. A great reduction in the fire hazard due to the use of low-cost and less volatile fuels. In short-haul helicopter operations, those of under 100 miles, large loads of reserve fuel will not be required so that maximum gains in pay load (resulting from the lighter weight of the engine) will be available.

On the whole, something on the order of a 40-percent increase in pay load in the 110-mile range will be available with the turbine-powered helicopter, as compared to a helicopter powered by a reciprocating engine of similar horsepower. A larger helicopter, having a pay load of about 5,000 lb, is expected to have a direct operating cost of something less than half that of any reciprocating-engine helicopter now in use commercially. Twin-turbine helicopters are also envisaged, and these will provide the additional reliability required for industrial operations. There is little limit on what such a flying crane can pick up, within its lift capabilities, or where it can deliver cargo.

To keep pace with these new developments, transmission towers and related gear can be profitably redesigned. Perhaps towers of aluminum may be a partial answer. They might be designed to be moved complete to the site after having been preassembled at some central location on a production-line basis.

Footing design and construction

Fully equipped power poles are laid out for pick-up by a hard-working whirlybird on power line in Santa Ana Mountains.

should be restudied for utilization of materials and equipment now available. Earth drilling equipment can quickly dig an adequate foundation hole for ready-mixed concrete, replacing the grillage type of footing. In some terrain the conventional cylindrical footing can be replaced with a rock anchor. In the past, the use of such an anchorage has been restricted to areas of solid ledge rock. Recently the Edison Company conducted a number of very successful pull-out tests on anchor bars grouted 10 ft into fractured, weathered or decomposed rock. Such bars can be relied on to safely develop pull-out resistance equal to the full allowable working load of the steel. This is a significant development as far as air lift is concerned, since it means that rock-anchor-type footings can be used at many more of the sites that are now made accessible by the helicopter.

The Southern California Edison Company plans to continue its efforts to develop better methods of utilizing the unique capabilities of the helicopter wherever such utilization proves expeditious and economical.

(This article is based on the paper presented by General Payne at the ASCE New Orleans Convention, before the joint session on transmission towers of the Power and Structural Divisions, presided over by Robert J. Drueding, a member of the Power Division's Committee on Session Programs, and Robert D. Dewell, chairman of the Structural Division's Executive Committee.)

Two applications of prestressed concrete

Two specific adaptations of prestressed concrete, quite different in character and use, are discussed in this article.
1. Composite prestressed girders used as the backbone in a streamlined roof framing system.
2. The design and erection of a composite prestressed sandwich wall-panel 61 ft long, standing vertically as the exterior wall of an electrical switching station.

PHILIP M. GRENNAN, F. ASCE, Engineer-Associate
Office of Alfred Easton Poor, Architects, New York, N. Y.

1. Composite prestressed girders

An economical solution to the problem of designing and building a warehouse for the McGraw-Hill Distribution Center in East Windsor Township, New Jersey, was found in the use of composite prestressed girders. The design criteria for this building were dominated by the need for the "earliest possible occupancy." The structural frame, including design, shop drawings, fabrication and erection, was given primary attention in solving the problem.

The minimum bay size dictated by the stock handling system was 25 ft 6 in. by 31 ft with a 16-ft clear height. On three sides of the building, provision was to be made for future expansion. Other requirements were a heavy-duty concrete floor for fork trucks and palletized operations, an enclosed truck dock area, a post office inside the plant, and a complete sprinkler system.

Preliminary studies

In the structural design, the focus was on a typical bay while, in the architectural studies, the major considerations were the overall layout and site adaptation. Six different basic structural designs were prepared, as well as several alternates and combinations.

Various structural steel designs were considered including continuous girders with rolled-section purlins supporting a metal roof deck or precast channel slabs.

Concrete frames of four types were studied:

1. Prestressed girders and precast twin-T's or precast long-span channel slabs.
2. Prestressed girders and precast joists with precast short-span channel slabs.
3. Prestressed girders and a combination of precast long-span channel slabs and short-span channel slabs.
4. Composite prestressed girders as a means of reducing the girder size and providing maximum headroom.

Both the minimum bay size of 25 ft 6 in. by 31 ft and double this size, or 51 ft by 31 ft, were analyzed. Costs were estimated for each design including columns and footings. Then the time element was evaluated and particular attention given to a basic design that would permit off-site fabrication to start immediately and continue while the design and working drawings were being prepared.

The various factors affecting total time and costs were discussed with the client. In the interest of early occupancy and long-term benefits the owners elected to pay an added \$40,000 for concrete over steel and another \$40,000 for the double-bay size.

For this added premium of about 37 cents per sq ft, various savings were anticipated: (1) \$6,000 in maintenance painting over a 5-year period; (2) elimination of painting hazards to stock and operations during this period; (3) \$1,000 in fire insurance a year; (4) a shorter construction time with more off-site fabrication, less congestion, fewer materials to store and less job facilities to be provided at the site; (5) a considerable saving in floor space by the elimination of alternate columns, thus permitting closer parallel rack storage and occupancy of the maximum area.

Final design

Twin-T prestressed roof deck was selected, spanning 31 ft, with the prestressed girder on the 51-ft span. Bearing plates were cast in the twin-T units and six stems per bay were welded to mating plates on the girders. These connections provided for alignment, erection bracing and final lateral continuity.

Burlap strips 4 in. wide were cemented over the twin-T joints to serve as breathing strips to dissipate moisture from the insulation. The insulation was a foamed concrete used as a means of providing a level surface for the built-up roofing.

Prestressed girders of 51-ft span were designed to take the initial dead

Single-story book warehouse has a twin-T prestressed roof deck spanning 31 ft, with the prestressed girder on the 51-ft span. Bearing plates were cast in the twin-T units and six stems per bay were welded to mating plates on the girders. These connections provided for alignment, erection bracing, and final lateral continuity.

for a warehouse

load of the girder, the roof deck, and the concrete cast in the field to complete the composite section. Then the girder was analyzed again as a composite section for total dead and live loads. A loss of 20 percent of the prestress was allowed for in both designs. This method reduces the size of the prestressed member. By casting the upper part in the field, the whole deck can be integrated.

Concrete having a compressive strength of 5,000 psi at 28 days was specified both for the prestressed girders and for the poured-in-place elements. The initial prestress of the concrete for the girders was 2,670 psi and the final composite prestress, including live load, was 2,250 psi.

Homogeneous material was assumed for both the prestressed and the composite girders. Although, theoretically, keys were not required for longitudinal shear, they were used as an added factor of safety. The web of the girder was notched over the columns to provide for sprinkler mains, and diagonal reinforcing was added at this point to resist concentrated stresses due to the change of cross section and localized diagonal tension. A 1-in. camber was formed in the bottom of the girder. Under full load there has been no apparent reduction of this camber.

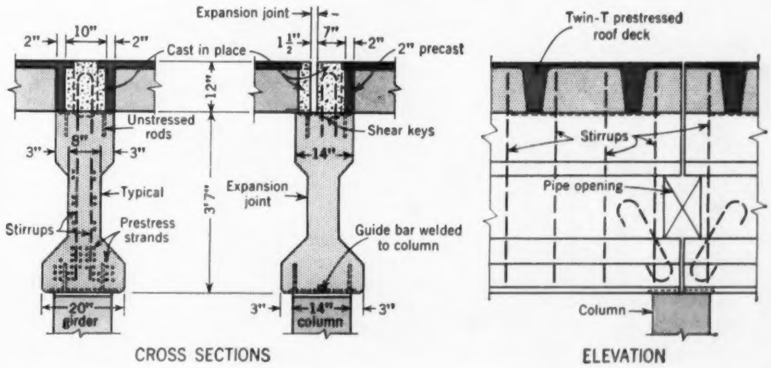
The spandrel girders were designed basically as interior girders to provide for future expansion. A notch was provided at the top of the section for a removable precast overhang.

The precast columns are typically 14 in. by 14 in., with bearing plates top and bottom. The top plate was provided for welding to the girder bearing plate and the bottom plate was extended for anchor bolts and designed to take the wind moments. See Fig. 1.

Slip joints were provided for expansion in the twin-T roof deck and the composite girders. These expansion joints divide the building into approximately five 200-ft squares.

The heavy-duty operating floor is supported on the ground and designed for a live load of 500 psi. Because of the high water table—11 ft below ground level—precautions were taken to protect against moisture penetration. Five inches of crushed stone was spread over a compacted subgrade

FIG. 1. Framing for the single-story warehouse includes precast concrete columns 14 in. by 14 in. and precast prestressed girders spanning 51 ft between columns. The girders over the columns were designed as composite members, with the top part of the girder cast in place after the deck was erected.



and a 1-in. sand bed was rolled on top of this stone. Then, on top of the sand bed, a polyethylene vapor barrier was laid. The 5-in. base slab came next—of 3,000-psi concrete containing two layers of mesh reinforcement. The wearing surface is a 1-in. topping of absorption-process concrete.

Formed construction joints were tooled and secondary relief joints sawed. (It is believed that an improvement could be made here by sawing all the joints at the top surface so as to eliminate the likelihood of "lipping" at tooled joints.)

Walls consist of precast concrete sandwich panels 6 in. thick with a calculated heat transmission factor of $U = 0.13$. The 2-in. insulation is centered in the panels and made continuous by the use of insulating spline joints. The panels are 6 ft by 17 ft and span from the foundation wall to the eave; all are removable. Corrugated steel forms were used to produce a pattern of vertical fluting on the outside surface.

As part of the coordinated program, a contract was let for all the structural elements of the building on the basis of a typical bay design, specifications, and scope of work. Fabrication of the prestressed members was well under way before the rough grading was completed and some eight weeks before the working drawings were finished. An estimated time saving of two months resulted from the off-site prefabrication of the structural elements and the walls.

Cost data

The precast "bones" of the structure, including columns, girders and roof deck erected, with the composite girders completed on the job, were contracted for at $1.92 per sq ft. This price included such things as openings, inserts, and sleeves.

The concrete sandwich wall-panels erected, complete with all fastenings and calking, with window frames cast in, were contracted for at $2.70 per sq ft.

The total job cost was $2.4 million or $11.10 per sq ft and 53 cents per cu ft. Included in this package are self-leveling truck docks, a highly mechanized stock-handling system, a post office, electrical substation, elevated water storage tank, a complete sprinkler system, incinerator building, pumphouse, all other utilities, roads and landscaping.

John Lowry, Inc., of New York, N. Y., was the builder, Atlantic Prestressed Concrete Co. of Trenton, N. J., was the concrete subcontractor. For the heavy-duty floor slab the subcontractor was the Kalman Floor Co.

2. Sandwich panels

Composite prestressed sandwich wall-panels 61 ft high and 4 ft wide, standing vertically, enclose the switching station of the Public Service Electric and Gas Company in Newark, N. J. The client requested that the roof area, which is used for outdoor equipment, be screened by a parapet 14 ft high. It was this requirement that eventually led to the design of a wall that would cantilever 14 ft above the roof level, thus eliminating bracing or other means of handling the wind stresses on a parapet wall.

The steel-frame building, which is 103 ft by 157 ft in plan, has very irregular floor levels. In some places the distance between horizontal supports for the wall is 24 ft. Removable panels without ribs had to be provided for replacement of large equipment.

Selection of a panel in the form of a vertical twin-T, with the stem on the outside of the wall, was actually the result of closely coordinated architectural and structural studies. The use of prestressing was primarily prompted by the need to provide for transportation and erection stresses.

As designed for this wall, the composite prestressed sandwich panel consists of a twin-T section 4 ft wide and $10\frac{1}{2}$ in. deep with $1\frac{1}{2}$ in. of insulation on top, covered by 2 in. of concrete to complete the sandwich. The overall depth of the composite section is 14 in.; the stems are spaced 2 ft on centers and project $8\frac{1}{2}$ in. to form the vertical ribs on the outside surface of the wall. The calculated heat transmission factor, U, has a value of 0.20.

Prestressing was limited to the twin-T section, and the centroid of the prestressing strands is located slightly above the neutral axis of the section. The top 2-in. layer of the sandwich is reinforced with normal rods. This layer was placed after the transfer of prestress. All concrete in the combined section was specified to have a compressive strength of 5,000 psi at 28 days.

Because of the 61-ft length of the panels, tongue-and-groove joints were considered essential for positive alignment. Shear ties were used as spacers and to fasten the two layers of the sandwich together. These ties also act as reinforcement for the solid concrete edges, which take the major part of the longitudinal shear. A nominal amount of longitudinal shear is taken by the insulation through its bond to the concrete. Above the roof the insulation was omitted and the solid concrete of this 14-ft parapet extension was carried down just below the can-

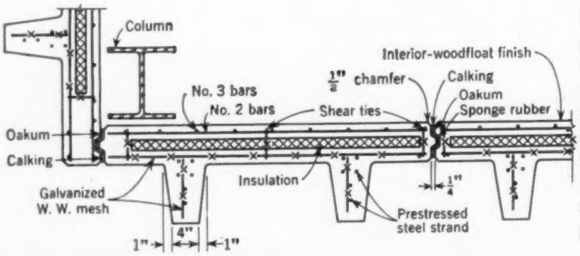
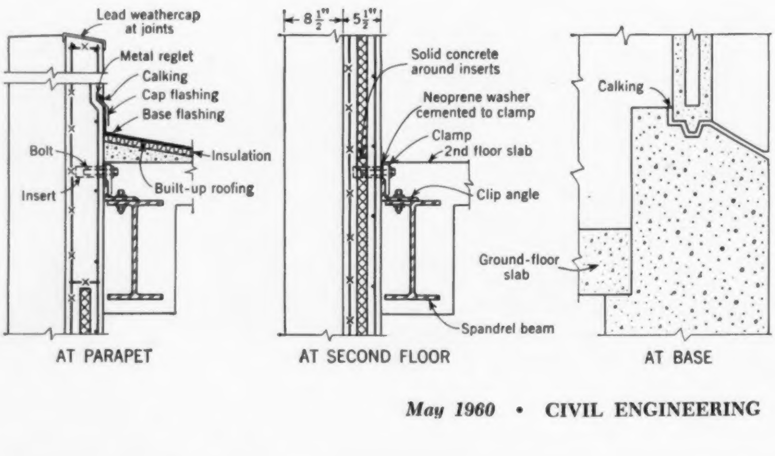


FIG. 2. Composite prestressed sandwich panel consists of a twin-T section 4 ft wide and 10½ in. deep, with 1½ in. of insulation on top covered by 2 in. of concrete to complete the sandwich.

FIG. 3. Vertical sections show connection of 61-ft sandwich panels to building frame at three different levels.



61 feet high

tilever support to take care of shear and diagonal tension.

Continuous metal reglet inserts were cast into the inside faces of the parapet walls for cap flashing, which serves as the termination for the roofing. The joints of the panels at the top of the parapet are sealed with a lead weather cap.

The panels were cast five at a time on a 320-ft prestressing bed, on a 48-hour cycle. The twin-T section was first prestressed to 744 psi (after losses). Following transfer of this prestress, the insulation and the rest of the reinforcing and concrete were placed.

Inserts were cast into the panels for attachment to the building frame and also for lifting eye-bolts. To somewhat distribute the 10-ton load while lifting, eight removable eye-bolts were placed on the inside panel face. Two additional eye-bolts were located on the top edge for handling when the panel was in a vertical position.

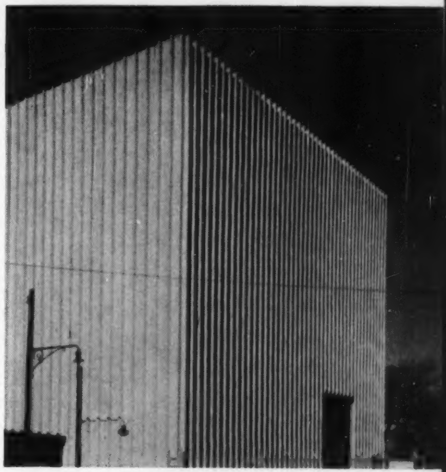
Fabrication was carried out in Trenton, N. J., and the units were transported to Newark, N. J., a distance of 50 miles, by truck and pole trailers.

One crane handled the entire erection operation. Cable rigging was attached to the eight lifting eye-bolts while the panel was still on the trailer. As the panel was lifted by the crane from its horizontal position, it was rotated into a vertical position. While the panel was thus suspended, the load was transferred to the top edge of the panel and all other rigging was removed. The crane then moved into position for placing the panel in its final vertical position in the building.

Before a panel was erected, a continuous, impervious, cellular rubber strip was cemented into the grooves with a rubber adhesive. After erection the vertical joints, on both faces, were packed with oakum and calked with a synthetic polysulfide calking compound. These joints, occurring every 4 ft, could actually be considered expansion joints, and of course they provide for easy removal and reuse of the units.

Fabrication and erection of the panels, which included all fastenings, joint material, and polysulfide calking, were carried out by the Atlantic Prestressed Concrete Company of Trenton, N. J.

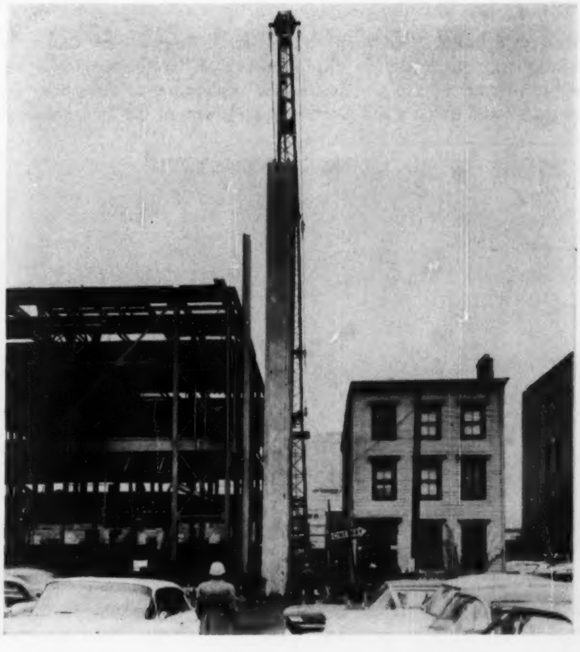
It was estimated that two months of construction time and a saving in first cost of $30,000 were realized through the use of this type of exterior wall as compared to a laid-up brick masonry wall. This saving amounted to approximately $1.00 per sq ft of wall area. Of course a further saving in heating costs will result from the lower *U* factor of the sandwich panels.



Closely coordinated architectural and structural studies resulted in the selection of a panel in the form of a vertical twin-T, with the stem on the outside of the wall.

(This article is based on the paper presented by Mr. Grennan at the ASCE New Orleans Convention, before a Structural Division session presided over by R. D. Dewell, chairman of the Division's Executive Committee.)

Composite prestressed sandwich wall-panel, 61 ft high and 4 ft wide, is being lifted into position. Eight removable eye-bolts were placed on the inside panel face to distribute the 10-ton load during lifting. Two additional eye-bolts were located on the top edge for handling when the panel was in a vertical position.



Construction

Stainless steel and glass will sheath the new $12 million, 20-story United Engineering Center that is rising opposite the UN Building in New York. Scheduled for completion in mid-1961, the Center will provide 180,000 sq ft of floor space.

"Every phase of construction of the United Engineering Center is on schedule or a little bit ahead"—that's the report from the construction site at 47th Street and United Nations Plaza in New York. Excavation and footings are complete. The basement walls have already been poured and waterproofed. Plumbing work has begun, and floor slabs are scheduled for pouring late in April. Steel erection is scheduled to start April 29.

Details of construction specifications recently made public by United Engineering Trustees reveal that the exterior of the structure will be sheathed in stainless steel and glass, with the exception of the west wall which will have a limestone covering. Window washing will be made easy by a motorized scaffold, suspended from the roof.

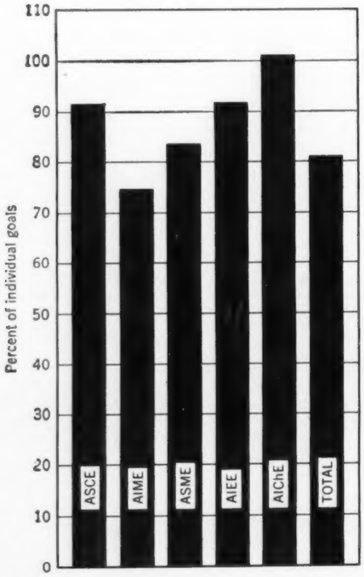
The lobby, with the main entrance on 47th Street, will be walled in marble with floors of terrazzo. Two corridors lead from the lobby to meeting rooms. On the east side, a display area of 6,235 sq ft will feature ceiling-height windows. For half of the area the ceiling height will be 15 ft with the other half rising 22 ft 3 in. Movable partitions in this area, as well as in the meeting rooms and dining rooms, will permit adaptation of the space to special purposes.

Elevators, along the west wall, will have speeds of 700 feet per minute. Four elevators will be installed to meet present needs, with provision for two more in the future when needed.

Provision for future expansion of office space has also been made on the northwest side of the building. The expansion could add as much as 8,500 sq ft of floor space on each floor from the third to the eighth and 6,000 sq ft on each floor from the ninth to the twelfth. Altogether, the Center will rise 283 ft above street level, including eighteen floors of office space and two of mechanical equipment.

The Engineering Societies Library and Engineering Index will be housed on the second floor, with reading room facilities for 74 persons at a time and stack facilities (including a small elevator) for an ultimate capacity of 225,000 volumes. Air conditioning,

Shoring for a building adjacent to the United Engineering Center is seen at right as foundations for the structure approach completion. The exterior basement wall has been bush-hammered in preparation for application of waterproofing. The building in the background houses the Carnegie Endowment for International Peace.



ASCE member giving for the UEC was 92 percent completed on April 8.

# of UEC—on schedule

with zoned control, will operate throughout the building. A light level of 75-foot candles will be maintained in all offices.

The architects for the building are Shreve, Lamb & Harmon Associates. Seelye, Stevenson, Value & Knecht are the structural engineers, and Jaros, Baum & Bolles, the mechanical engineers. The prime contractor is the Turner Construction Company. The Thomas Crimmins Contracting Co. has completed the foundations.

Fund-Raising Goes On

Meanwhile, in the fund-raising campaign for the Center, end-of-month returns show that the American Institute of Consulting Engineers has joined the American Institute of Chemical Engineers in achieving 100 percent of its quota, and the American Institute of Industrial Engineers has passed the 85 percent mark.

The four Founder Societies have achieved the following percentages of their quotas: ASCE 92 percent; AIEE 92 percent; ASME 84 percent; and AIME 75 percent. Total member giving is 81 percent completed.

The industrial campaign has collected approximately $4,900,000, in gifts and pledges.

In the meantime, the compaign in the Local Sections continues—with encouraging results in several areas of the country. Since UEC activities were last reported the San Francisco Section has made its quota and is No. 36 on the Honor Roll. The remaining 42 Sections are from $305 to $17,486 short of their goals (see the accompanying tabulation).

However—to quote from a recent letter of Executive Secretary Wisely to fund-raising personnel—"There are encouraging signs that the ASCE campaign is being fired up again in several of the key Sections, such as Los Angeles, Texas, Oregon, Pittsburgh, St. Louis, and Massachusetts." Mr. Wisely also notes that in several areas an organized drive is being opened among contractors, equipment companies, and material suppliers. This, he thinks, could be "a source of substantial return if the solicitations are made with enthusiasm and confidence. Determination will also help."

On the credit side, also, is the fact that District 3 has now joined Districts 1, 4, 8 and 9 in the 100 percent plus group. Zone I, it will be remembered, exceeded its quota sometime ago.

With the Society only 8 percent from the $800,000 goal it has set for itself, all that is needed now for victory is the runner's final sprint. The watchword is

LET'S GET THE JOB DONE
—BY JUNE—

Never mind the formalities!

Just make out a check to the United Engineering Trustees and mail to ASCE at 33 W. 39th St., New York 18, N. Y. Your contribution will be promptly credited to your Local Section, and the formalities handled by the headquarters staff. Send along a note telling what your contribution will be for the next two or three years. It does not have to be on the special card.

If you prefer, pay nothing now! Just tell us what you can contribute, and the staff will take care of the details!

LET'S GET THE JOB DONE
—BY JUNE—

UEC HONOR ROLL

Once again CIVIL ENGINEERING takes pleasure in listing the Sections that have met their quotas in the drive for funds for the UEC. The current Honor Roll carries 36 Sections, listed in the order of meeting their quotas. Newcomer to the list this month is the San Francisco Section.

Kentucky (122)
Lehigh Valley (138)
Nashville (102)
Cincinnati (141)
Columbia (133)
Philadelphia (152)
Hawaii (128)
Rochester (123)
Ithaca (142)
Southern Idaho (200)
Indiana (138)
Delaware (109)
Kansas City (116)
Central Pennsylvania (109)
Arizona (110)
West Virginia (140)
Central Ohio (107)
Tri-City (116)
Puerto Rico (117)
Wisconsin (105)
Georgia (109)
Maryland (108)
Tennessee Valley (107)
Metropolitan (114)
Connecticut (107)
Maine (103)
Rhode Island (100)
Alaska (105)
Central Illinois (107)
Syracuse (107)
Illinois (103)
Nebraska (105)
Iowa (105)
Duluth (100)
Virginia (100)
San Francisco (101)

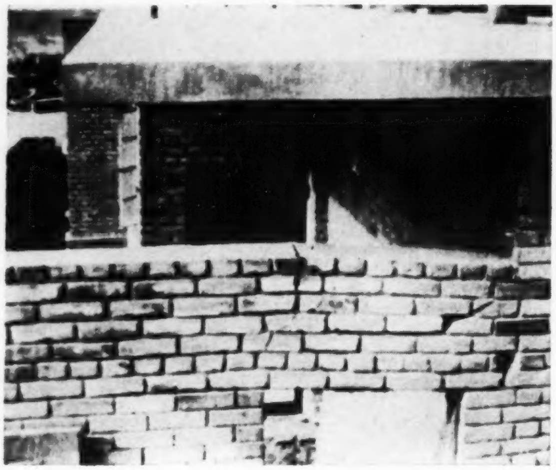
Total Amounts Necessary to Meet Local Sections Quotas

Panama	$305	Cleveland	$1,960
Spokane	333	Miami	1,995
Buffalo	360	St. Louis	2,033
Tacoma	376	Mohawk-Hudson	2,087
Mexico	675	Rep. Colombia	2,145
Montana	688	Venezuelan	2,183
South Dakota	879	South Carolina	2,307
Mid-Missouri	883	Sacramento	2,768
New Hampshire	977	San Diego	2,789
Wyoming	1,005	Pittsburgh	3,163
Dayton	1,074	Texas	4,046
Oklahoma	1,076	Northwestern	4,198
Akron	1,077	Mid-South	4,259
Intermountain	1,090	Alabama	4,493
Toledo	1,172	Oregon	5,109
Mass.	1,303	Louisiana	6,595
Seattle	1,609	Florida	7,378
Brazil	1,795	Colorado	8,292
New Mexico	1,830	Michigan	9,585
North Carolina	1,869	Nat'l Capitol	11,530
Kansas	1,884	Los Angeles	17,101

(More ASCE News, page 76)

Typical of thirteen houses that failed shortly after construction in an area underlain by expansive clay in Talara, Peru, is this one-story dwelling. All these houses had masonry walls, flat concrete roofs and spread footings placed about 3 ft below ground level.

Dangerous cracking forced occupants of house T-3 to move out less than 16 months after its construction. Cracks over the service door are shown.



Experience with expansive

FORREST D. CLARK, M. ASCE, Chief Estimator, Abadan Refinery, Abadan, Iran; formerly Senior Project Engineer,

The action of expansive clay in Talara, Peru, has caused disastrous cracking in thirteen houses constructed there in recent years. Plaster fell from the walls and ceilings, and cracks up to ¼ in. wide opened in the brick masonry walls. Door frames were forced out of plumb and terrazzo tile floors were cracked and rose in places over ½ in.

Talara, a small town on the Pacific coast of Peru, is in a valley surrounded by a barren clay escarpment which rises to a height of about 150 ft. Most of the valley floor is a deep layer of fine-grained sand, but ridges of clay from the escarpment extend under the sand like fingers. In the past, engineers and constructors who did not appreciate the treacherous nature of the clay, built structures whose footings rested partly on the sand and partly on the clay.

The International Petroleum Company, Ltd., constructed a number of houses for its employees, and by chance some of these were built in an area underlain by veins of clay. The houses were constructed with masonry walls, flat concrete roofs, and spread footings placed about 3 ft beneath the ground. Since rain is rare along the coast of northern Peru (a major rainfall is likely to occur only about once in seven years) a house might stand indefinitely without having water reach the clay under the footing from natural causes. However, as soon as the new houses were occupied, the tenants planted lawns and shrubbery which they supplied with liberal quantities of water. Thirteen houses suffered severe cracks and required major repairs. House No. T-3, completed in May 1953, was in such bad condition by September 1954 that the occupants were forced to move out.

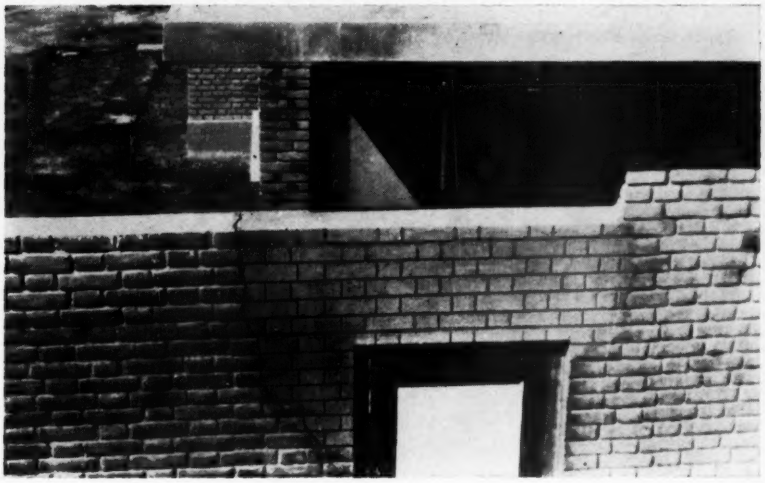
The contractor, Graña y Montero of Lima, attempted to repair the house by underpinning. The foundations were carried to a depth of 3 m (10 ft) by pillars of reinforced concrete resting on new spread footings. The spaces between the concrete pillars were filled with brick masonry. Altogether 96,690 soles ($5,100) was spent on foundation repairs. The house was completely renovated, and reoccupied. Shortly however, the walls began to crack again and the house had to be abandoned for the second time. This was the situation when the writer first viewed the structure in September 1956. All the old cracks had reopened, and the house was considered to be in worse condition than in 1954.

Soil conditions studied

A rotary drill, formerly used for drilling seismograph shot holes, was pressed into service for a subsoil exploration. Borings revealed that three corners of the house rested on a deep layer of stiff gray clay and that the fourth corner was supported by fine sand. See Fig. 1. The sand extended to a depth of 28 ft, below which the same gray clay was encountered.

Since the nearest soil laboratory was in Lima, about 900 miles from Talara, it was necessary to resort to field tests to determine the nature of the clay under this house.

The expansive properties of the clay were first discovered by a free-swell



After the attempt at underpinning, new cracks appeared over the service door of house T-3.

In a futile effort to combat cracking in house T-3, the contractor tried underpinning. He carried pillars of reinforced concrete down about 10 ft to rest on new spread footings.

clay in Peru

International Petroleum Company, Ltd., Talara, Peru

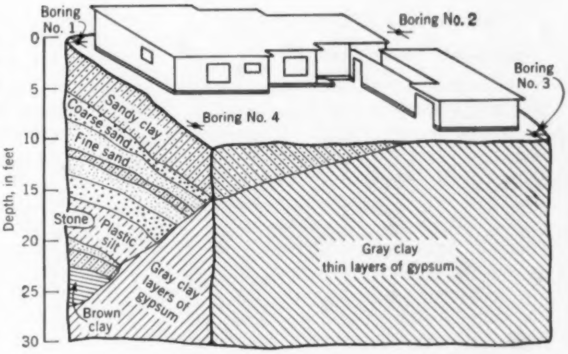
test. A 10-cu cm sample of air-dried soil was passed through a No. 40 sieve and placed in a graduated container filled with water. After the soil sample had been allowed to settle, the expanded volume was found to be 22 cu cm. To find the free-swell value, the following expression was used:

$$\frac{\text{Final volume} - \text{Initial volume}}{\text{Initial volume}} \times 100$$

The free-swell value was found to be 120 percent. Wesley G. Holtz, M. ASCE, and Harold J. Gibbs, A. M. ASCE ("Engineering Properties of Expansive Clays," ASCE *Transactions*, vol. 121, 1956, p. 641) found that soils with free-swell values of 100 or more are usually troublesome.

Next the uplift capability of the gray clay was measured by a full-scale load test, the test apparatus consisting of a 5-sq ft bearing plate, a 10-in. pipe welded to the bearing plate, and a 50-bbl tank mounted on the 10-in. pipe. The apparatus was steadied by guy ropes, and the load was applied by adding water to the tank. Close to the bearing plate a small concrete slab was

FIG. 1. Soil profile under house T-3 was revealed by borings. Three corners of the house were found to rest on a deep layer of stiff gray clay while the fourth corner stands on fine clay.



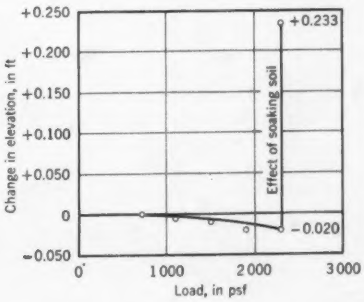


FIG. 2. The uplift capability of the expansive gray clay was measured by a full-scale load test. Load was applied to a bearing plate in increments up to a pressure of 2,300 psf. After settlement stopped, the soil around the bearing plate was soaked with water. The bearing plate was lifted a distance of 0.233 ft. On drying there was no resettlement.

poured and left without load during the test.

Load was applied in increments up to 2,300 psf, which was slightly greater than the load on the foundation of house T-3. After settlement stopped under the applied load, the ground around the bearing plate was soaked with water. Soaking and drying were carried through three complete cycles, and settlement measurements were taken at intervals. The test pressure on the soil was not changed during the wetting and drying cycles.

Wetting of the soil caused the bearing plate to rise a distance of 0.233 ft. See Fig. 2. The corner of the small concrete slab nearest the bearing plate rose 0.785 ft and the corner furthest from the bearing plate, 0.527 ft.

This load test clearly demonstrated the ability of the clay to lift a house foundation enough to ruin masonry walls. Also it demonstrated what the clay could do to an unloaded concrete floor slab. Two other interesting facts were noted:

1. Over 85 percent of the rise caused by each wetting occurred within 24 hours.
2. After the ground dried out there was no resettlement.

Corrective measures consisted of placing around house T-3 an asphalt pavement 3 m wide and a French drain along the outer edge of the asphalt. In December 1956 the house was completely repaired and reoccupied, and the new occupants planted a lawn, which extends over the French drain. Only a few hair cracks have developed in the house walls and the floors show no sign of uplift pressure.

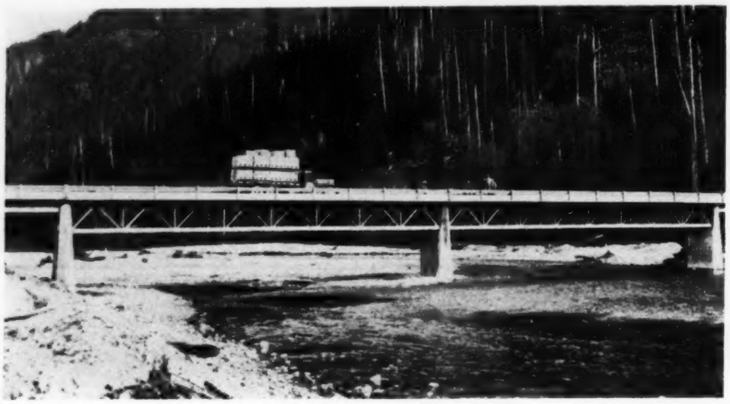
Trouble with sewer pipe

A large amount of locally made concrete sewer pipe has been laid in the Talara area, and several breaks have occurred where the pipe passes through beds of clay. Apparently enough moisture can seep through the pipe walls to cause the clay to swell and fracture the pipe. It has been recommended that, where the pipe passes through clay, it be surrounded with at least one foot of sand. To the writer's knowledge no pipe surrounded by sand has been broken.

Experience in Talara indicates that there are only two sure ways to deal with expansive clay—remove it or keep it absolutely dry.

For information used in this article, the writer is indebted to Mr. Z. Aliaga, who made the borings at house T-3, and to Mr. J. Wilson, who performed the soil-bearing tests. Both are members of the engineering staff of the International Petroleum Company, Ltd., at Talara, Peru.

This single-lane, heavy-duty logging bridge was recently put in service over the Upper Baker River in the Cascade Mountains of Northwestern Washington. Overloaded truck was used to evaluate the load-carrying capacity of the structure.



Heavy-duty

HOMER M. HADLEY, F. ASCE,

An unusual, even a pioneering, design was chosen for a heavy-duty logging bridge across the Upper Baker River in the Cascade Mountains of Northwestern Washington. The two channel spans of 100 ft each put the bridge in a size range such that all-steel trusses, steel plate-girder, or prestressed concrete girders could have been chosen as the main load-carrying members. Instead, composite construction was decided on. The reasons for this choice and the adverse consequences that would have followed any of the other possible choices will be discussed here.

This single-lane logging bridge, which has recently been load-tested and put in service, is 270 ft long, made up of two 35-ft end spans and two 100-ft channel spans. It has a 14-ft roadway and unusually heavy marginal curbs, making the overall concrete width 16 ft 6 in. It will be subjected to the occasional passage of a 70-ton log-loader, which will cross slowly and without impact, centered on the roadway. The load will be uniformly distributed on track 15 ft long, 3 ft wide, and spaced 9 ft on centers. This will exert the permissible 25 percent overstress. The bridge is also designed for H20-S16 trucks, with impact and in eccentric position.

Its distinctive features are:

Composite steel-prestressed concrete trusses for the two main spans, having post-tensioned concrete bottom chords and structural steel webs and top chords.

Precast concrete roadway slabs of the full 16-ft 6-in. deck width, the edges or margins of which do not rest on supporting beams or girders.

The structural integration of these precast concrete slabs with the steel top chords of the trusses and the connection of these slabs with one another at all the numerous transverse joints so as to establish reliable composite action between the several parts.

Not notable and not orthodox in some circles, but particularly useful with precast concrete slabs, is the asphaltic concrete topping that covers the roadway from curb to curb. This topping eliminates all surface irregularities in the slabs and at the joints between the slabs and avoids the necessity for painstaking finishing of the slabs when they are first formed and struck off.

Precast slabs are seen in place on deck of bridge. The transverse joints have been concreted, the spaces between slabs and trusses filled, and the hold-down bolts covered. After the curbs were formed, the asphaltic roadway topping was applied.

Horizontal joints between slabs and trusses were filled by pouring mortar through an inverted slump cone. A rubber plunger was then used to force the grout downward laterally along the joint.

composite bridge

Consulting Engineer, Seattle, Wash.

Water impounded behind the recently completed Upper Baker River Dam has completely submerged the Forest Service bridge that crossed the former Baker River several miles above the dam site. This bridge had to be replaced, to the satisfaction of the Forest Service, at a new site above pool level across the Upper Baker River. Stone and Webster Engineering Corporation, engineers and constructors for the Puget Sound Power and Light Co., owners of the dam, ascertained the requirements of the Forest Service and arranged for the necessary engineering plans and construction.

Plans were developed by the writer, and a contract for the construction of the bridge was awarded to the Associated Sand and Gravel Co. of Everett, a firm with extensive experience in precast concrete work.

The channel spans are 100 ft long, center to center of piers, making the trusses 98 ft 4 in. center to center of bearings. As previously mentioned, the questions that at once arise are: Why composite construction? Why not all-steel trusses? Why not steel plate-girders? Why not prestressed concrete girders? Unquestionably any of these alternates could have been employed but all entailed adverse consequences.

AASHO specifications prefer a depth-to-span ratio of 1:10 for trusses, presumably on the basis of stiffness. Here that ratio with the composite trusses, based on the overall dimension, is 1:14. Since the required clearance between the truss and the graded river channel is 15 ft, any increased truss depth would have heightened the fills on the bridge approaches. As for steel plate girders, they appear not to have fared too well competitively against prestressed concrete girders in the past, and as for prestressed concrete girders, the difficulties of access to this site, their great weight and, to a certain extent, the hazards attendant in their hauling and erection, all weighed against their use. The composite truss can lie over on its side without change of appearance; the prestressed girder cannot, at least without disastrous consequences. The great stiffness the prestressed chord imparts to the truss—vertically, horizontally and torsionally—was likewise attractive. When a lower bid was received for it than for prestressed concrete, the choice was for composite trusses.

The performance of the test truss reported by the writer in CIVIL ENGINEERING for November 1958, vol. p. 829, demonstrated the behavior to be anticipated from such trusses in a bridge, and the writer had no hesitancy in recommending them in this case.

The site location, about 85 miles distant from Everett, Wash., and about 25 miles distant from the nearest source of board, lodging and minor supplies, was a major consideration in determining the type of bridge. Those last 25 miles, over roads that are crooked both horizontally and vertically, hold opportunities for very considerable future improvement.

Composite truss

The composite truss used is 99 ft 4 in. in overall length, and 98 ft 4 in. center to center of bearings. It is 6 ft deep, center to center of chords. The top chord is a 12 WF 65 section and the bottom chord is a 12-in. by 17-in. rectangle of 6,000-lb concrete, post-tensioned with four 1¼-in. Stressteel bars and reinforced with eight No. 8 continuous corner bars. No. 2 loop binders are 10 in. on centers, with additional binders at panel points.

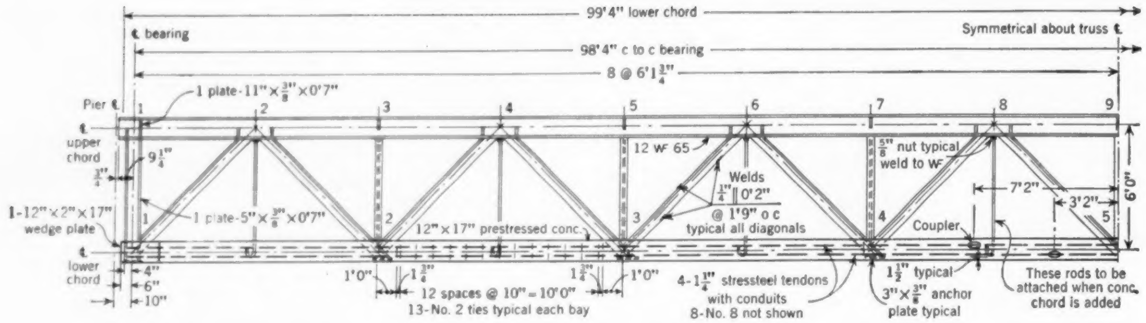


FIG. 1. Truss elevation of two 100-ft spans shows prestressed-concrete lower chord with structural-steel web and top chords.

Web members are pairs of angles, back to back, 4 in. by 4 in. at mid-span, 6 in. by 4 in. at the ends. These are connected to the concrete in a simple way. The tension angles extend to within 2 in. of the bottom of the section and have a ½-in. by 4-in. plate welded lengthwise of the stem legs. The compression angles are welded against the tension angles. The 4-in. wide-flange posts, coming squarely to the panel points, are welded equally to both the tension and the compression angles. The prestressing and reinforcing bars pass by on either side and the additional joint binders provide lateral confinement. It is impossible for the tension member to withdraw from its position without major rupture of the concrete and distortion of the truss.

No structural steel connects the successive lower-chord panel points. When fabricated, the web members are attached only to the top chord. At the end joint a very satisfactory detail was developed which confines the concrete laterally between short lengths of 12-in. channel welded to the bottom bearing plate and cross tied at their tops. For the connection of the end post, an 8 WF 24 was used as the end vertical. Against its flange, embedded in the concrete, the end post is welded and has its bearing. The heavy Stressteel wedge plate closes off the end of the concrete. See the accompanying Figs. 1 through 5.

Another interesting possibility for the composite truss was utilized here. The cost of hauling long members is naturally much greater than that for short members. These steel truss sections were shipped from Seattle to Everett in two nearly equal parts and the parts, aligned for grade and direction, were welded together with a compression weld, in the top chord only, at Everett, the joint coming at an upper panel point where the web members met but did not come in contact with one another. This same procedure could well be adopted with sections of considerably greater combined length, say 180 ft, which could be shipped to the job site in, say, three pieces—with or without the concrete bottom-chord sections attached. At the site the sections would be joined and post-tensioned.

As originally proposed, cross-bracing between the trusses was provided at every second bottom-chord panel-point and the bottom lateral system was omitted. Not because it is normally needed but as a safeguard against the impact of drift in some great, 50-year flood, the Forest Service requested that a bottom lateral system be installed, or in lieu of that, cross-bracing at every panel point. The latter was provided. It is a fact that in the heavily timbered areas of western Washington and western Oregon, rivers in flood frequently carry large trees whose washed-out roots may project high above the water and deliver heavy blows against whatever they strike. It was with such a contingency in mind that the additional cross-bracing was provided.

At the beginning it was planned to have the structural steel fabricated in Seattle and shipped to Everett where the bottom chord was to be added and post-tensioning performed. Then the trusses were to be shipped separately to the bridge site, there to be erected and cross braced. The Seattle and Everett steps were carried out as planned while pile driving and pier construction were under way at the site. As the time for shipment of the structural steel approached, the contractor and his staff became convinced that the best and most economical procedure would be to ship the trusses in pairs, fully cross-braced with steel and additionally cross-braced temporarily with timbers. This gave a 9-ft 5-in. width of load, requiring a special permit, which was obtained. These pairs of trusses, suitably piloted and guarded, mounted on a truck and steering trailer, were successfully delivered to the site. Thus assembled and braced, a pair of trusses weighed a few tons more than a single standard prestressed beam of the same length.

The Upper Baker River had no fixed and well-defined course but from time to time had broken over its low banks and created a new bed for itself. During construction it was diverted to flow in a channel a few hundred feet southeast of the bridge, and a new channel for it was graded beneath the bridge where it now flows. Henceforth the approach fills presumably will restrain its wanderings and maintain it beneath the bridge. It is subject to sudden floods and freshets in its upper reaches. When the bridge was being erected, the graded river bed was still dry, and the trusses and bracing of the

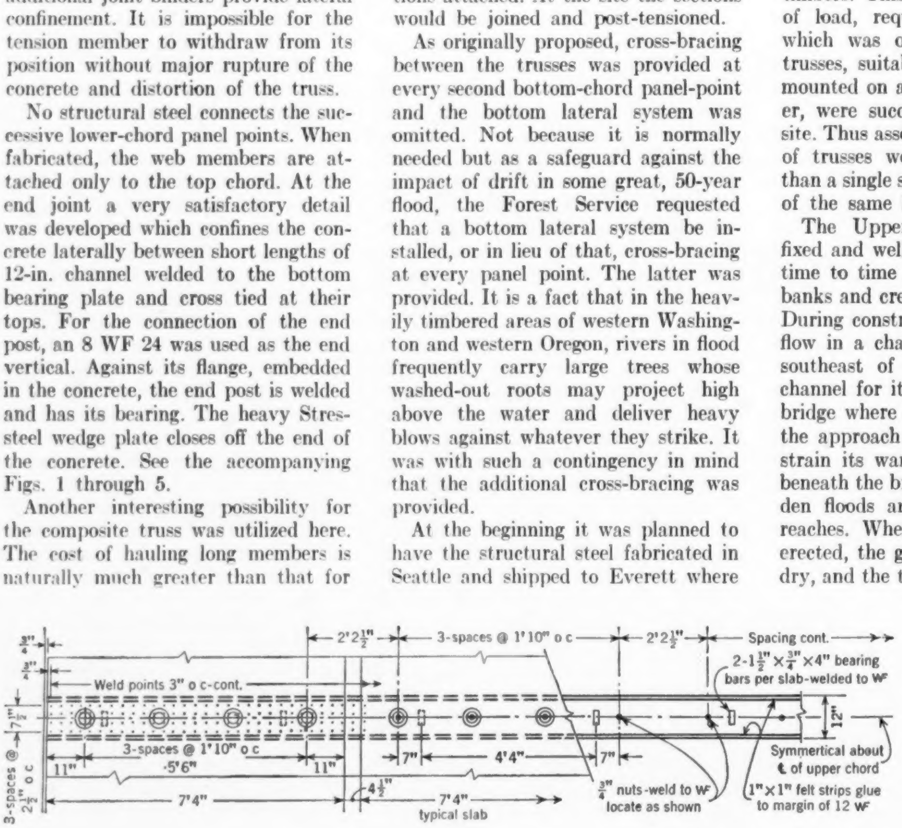


FIG. 2. Plan of upper chord indicates weld points and hold-down bolts.

complete span were lifted and swung bodily into place by a 25-ton crane at each end. Both 100-ft spans and their total of 26 precast roadway slabs were erected and placed in two days.

The work emphasized what is evident whenever a bridge deck is poured in place—the result is most satisfactory but its creation is difficult and expensive. Forms must be built and supported. Reinforcement must be placed; concrete must be poured, finished, cured. Finally, forms must be stripped and disposed of. Where these operations can be performed under the favorable conditions in a concrete products plant, so that the field work is reduced to the transportation, placement and connection of precast roadway slabs, a great simplification results and also a substantial saving in costs.

Connections

The difficulties affecting such a substitution are all inherent in that single word "connection." Precast slabs must be connected to whatever supports them, whether steel or concrete, if composite action between the two is to be developed. They must also be connected with one another at all the numerous transverse joints so as to establish longitudinal continuity.

At this juncture standard practice stands firmly opposed to any such developments, at least in the Pacific Northwest. For composite action between poured-in-place slabs and supporting steel beams, it is required that some conventional form of shear connector be employed. Whatever this connector is, it is used at a computed spacing, not over 2 ft apart, and attached to the supporting beam by welding. It projects upward several inches, becoming embedded in the concrete when it is poured. If the supporting beam is concrete, the hazard of slab connection is apparently greater for not only do stirrup ends project up into the slab from naturally rough concrete surfaces but a series of depressions must be created in the top of the beam, usually to a depth of 2 in. by wood blocks, which are crowded down into the top of the beam when it is poured. These depressions, the so-called "shear keys," fill with concrete when the slab is poured and create an additional interlock. They are likewise smooth sided and trap dirt—but they are "standard practice."

Again, according to standard practice, transverse joints in the roadway slabs must be strengthened by marginal beams. There is no question that the edge of a slab, alone and by itself, requires supplementary support but where two edges abut, the need for marginal beams is far from urgent.

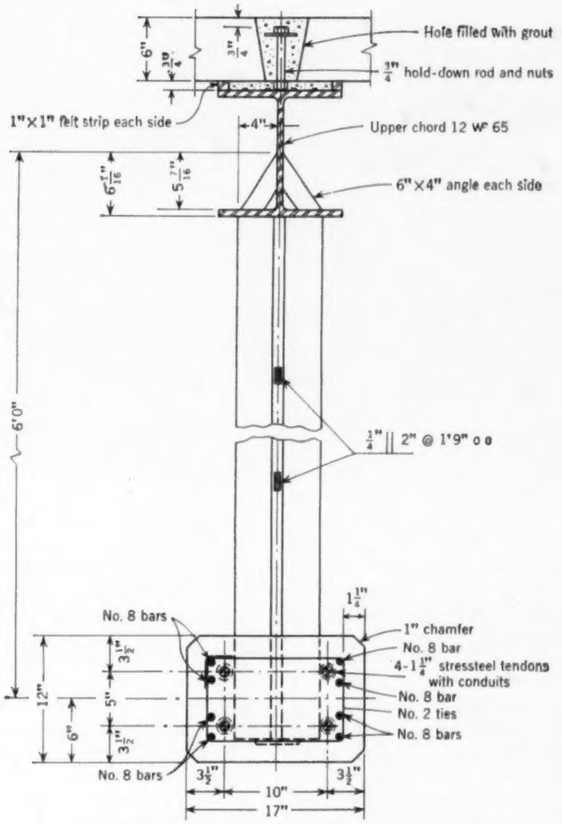


FIG. 3. A typical section through the truss.

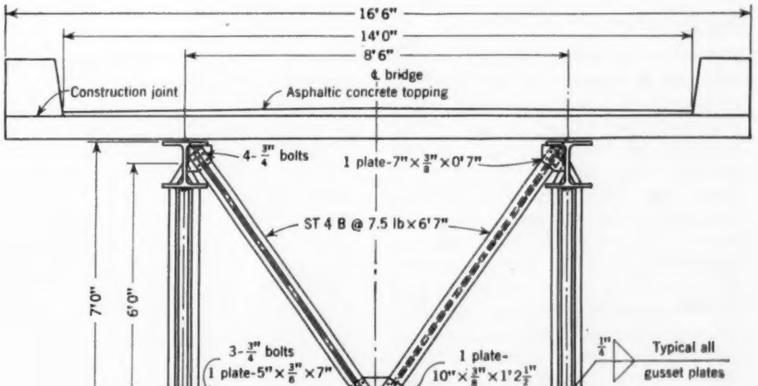
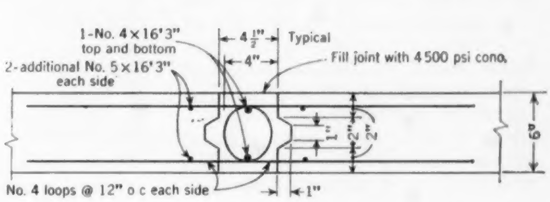


FIG. 4. Typical lateral bracing is shown for alternate panel points: L_1U_1, L_2U_3, L_3U_5, L_4U_7, and L_5U_9.

FIG. 5. Poured-in-place joint between precast slabs.



Both these "standard practice" requirements provide a means of obtaining support and interlock but not the only means. Marginal beams are not indispensable, particularly when they interfere with the easy use of flat-undersided precast slabs. As has been shown, the use of precast slabs was most desirable in this bridge.

Various tests—Skunk River, Iowa, San Leandro, Calif. and elsewhere—have shown that composite action is developed between steel beams and concrete without any shear connectors at all when the concrete is simply poured over the top and edges of the beam's top flange and when the steel is subjected to compression. When the concrete is in the form of precast slabs, pouring over the top flange of the supporting steel member is obviously impossible. Not at all impossible, however, is the introduction of a layer of rich mortar between the precast slabs and the steel members to create bond between them. Such a mortar layer with roughened steel and concrete surfaces, and in combination with bolts to prevent separation, would be simple to install and appeared the logical way to accomplish the desired result. However, this method of connection was approved and adopted only after careful reconnaissance tests at the University of Washington. These tests, on a mortar layer exactly like this, with a roughened surface, showed shear strengths of over 400 psi without failure.

No shear keys

The sole mechanical interlock of steel to mortar consisted of weld points, spacer blocks, and hold-down bolts. The sole interlock of slab to mortar was provided by the aggregate-exposed surface of the slab and the same hold-down bolts. There were no shear keys.

Actually the horizontal shear between slabs and trusses is not of great magnitude, since the trusses carry all dead loads except those of curbs, joint filling and asphaltic topping. The trusses carry a small part of these remaining dead loads and a small part of the live loads. But assuming that the flexural stresses induced by these loads are transferred in their entirety to the slabs, the maximum horizontal shear is less than 90 psi. Thus there appeared to be no great hazard involved in using weld points along a top chord that is everywhere in compression. These were used in conjunction with a 3/4-in. layer of 1 to 1 1/2 mortar and eight 3/4-in. hold-down bolts in each slab, these being spaced at 1 ft 10 in. along each truss. Spacing of weld-point rows along the truss center-line is 3 in. on centers; spacing in the rows, four per row, is 2 1/2 in. Weld points were specified to be about 3/8 in. in diameter and about 1/8 in. high. The dead weight of the deck and the live loads assist the hold-down bolts in preventing separation of slabs from truss.

It is equally necessary that the numerous transverse joints between the precast slabs be full and tight and be capable of transferring wheel loads from one slab to the next. A detail of the joint used is shown in Fig. 5. Of it, we can say that it works.

An accompanying photograph shows the appearance of the deck after the slabs had been set, grouting completed and transverse joints poured. This view also shows how the horizontal joints between the slabs and trusses were filled. The equivalent of a slump cone is inverted in a hole and mortar is poured into it. Then a man presses a rubber plunger downward in the cone to push the grout down and laterally. When the grout is clearly visible in the next hole or joint, operations are discontinued at the first hole and shifted to the next. This procedure is continued until the work is completed. The concrete of the transverse joints is vibrated into place. Both it and the slab concrete are of 4,500-psi strength.

Mention has been made of the heavy curbs. They are indeed massive; their height is 15 in. and their thickness 15 in. at the base and 13 in. at the top. Poured in place, they perform a very valuable service as marginal stiffening and distributing members for the precast roadway slabs. Of the 33 1/4 cu yd of poured-in-place concrete in the deck, 29 1/4 cu yd are in the curbs, 4 cu yd in the transverse joints.

The 35-ft approach spans consist of pairs of prestressed beams, 12 in. wide, post-tensioned, with precast slabs. Again composite action was developed by means of a mortar layer. Aggregate was exposed in strips 12 in. wide on the under sides of the slabs directly over the beams. Upstanding marginal strips of concrete, 1/2 in. by 1 1/2 in., were made monolithic with the beam concrete and on them were glued felt strips 3/8 in. by 1 1/2 in. The 9-in. width of beam top between the marginal strips was roughened by scoring transversely with a coarse brush, and hold-down bolts were used. There are no shear keys. Deflections under load are negligible.

The value of the asphaltic topping used on this bridge is evident in the photograph previously referred to. The slabs were made uniform in thickness but careful finishing was omitted. Neither was joint finishing painstaking, and continuity of slope between adjoining slabs was of no importance. The asphaltic topping, covering and sealing the roadway, easily eliminates all these deficiencies and provides the smooth-riding surface so much to be desired.

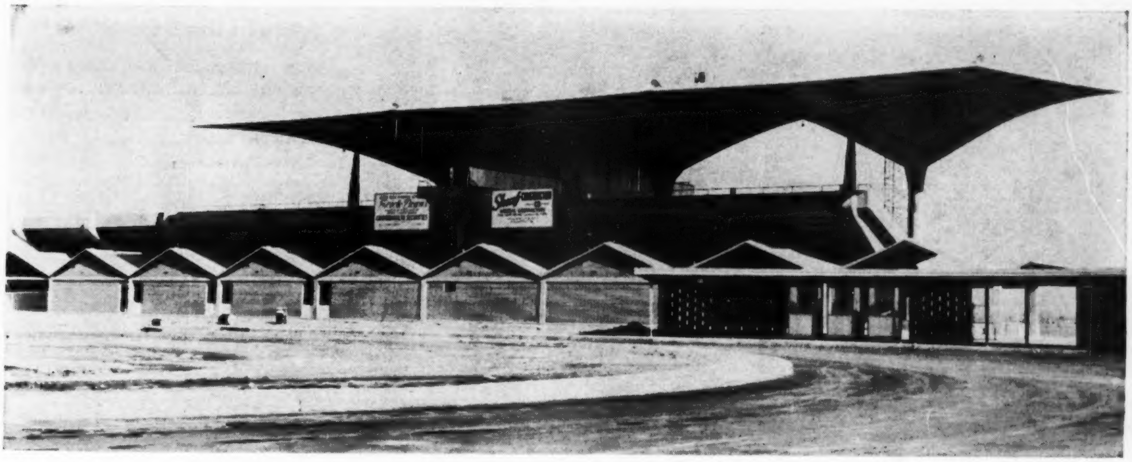
The proof of any construction is its ability to function satisfactorily. This bridge was designed to carry H20-S16-AASHO 44 loading and an occasional 70-ton log-loader. With permitted overstress, no impact and central positioning, the log-loader at midspan is substantially equal in its effects to the H20-S16 truck with impact and eccentric positioning. To obtain a reasonably fair evaluation of the load-carrying capacity of this bridge, an available truck loaded—in fact, decidedly overloaded—with solid concrete blocks was driven across and the deflections were measured at the ends and at midspan when the loaded truck was stopped at these points.

Proved by test

The forward single-axle of the truck was under the engine. Fourteen feet to the rear was the centerline of the pair of dual-tired, dual axles under the truck bed. Total load, truck and concrete blocks was 84,800 lb. This highly illegal single truck load was transported to the bridge on two trucks and there transferred to one truck. This produced slightly greater stressing than the static equivalent of H20-S16 loading with a 22 1/2-percent impact. About three-quarters of this total load came on the rear dual axles. Deflections were measured on top of the upstream and downstream curbs, opposite the centerline of the rear duals.

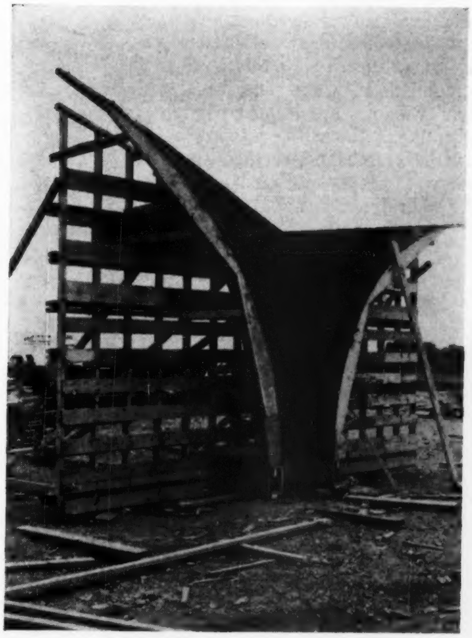
On the west span, with the truck centered on the roadway and at midspan, the average of the two deflections was 3/16 in. On the east span, the average of the two deflections was 1/4 in. On the west span, with the truck's tires brought in prescribed close proximity to the respective curbs, the upstream truss deflected 3/8 in., the downstream truss 1/2 in. On the east span, the upstream truss deflected 3/8 in., the downstream truss 1/2 in. This eccentric positioning increased the truss load 47 percent. The end deflections with maximum shear load centered, were negligible. With the load at the curbs, on the west span, the downstream truss yielded 3/16 in., the upstream truss 1/8 in.

It was concluded that the construction was adequately composite in all its parts, the more so because a deflection of 1/800 of the span would have amounted to nearly 1 1/2 in. and because a failure of the shear connection between precast slabs and the steel top-chord of the trusses would have resulted in deflections of greater magnitude—in fact of appreciably greater magnitude—than those observed.



Hyperbolic paraboloid roof for a grandstand

R. M. GENSERT, F. ASCE, Gensert, Williams & Associates, Cleveland, Ohio



Masonite on a wood backing was found best for forming the column-to-shell transition.

Scioto Downs is a new harness-racing track located on a 140-acre tract nine miles south of downtown Columbus, Ohio. It consists of an all-weather ⅝-mile track, a three-level grandstand seating 2,600 people, a parking lot for 5,000 cars, a clubhouse and horse barns. The cost of the facility was $2¼ million.

The grandstand has the world's largest concrete roof of the inverted umbrella type. It was nominated by District 9 of ASCE for the Outstanding Civil Engineering Achievement Award for 1960. Extraordinary cooperation among the architects, engineers, contractors, precasters and material suppliers resulted in a rapidly built, well coordinated job.

Mock-ups of tricky forming and scale models for the reinforcement detailers reduced field problems. At a prebid conference, a wooden model was used to illustrate the construction of a doubly curved surface with two sets of straight lines. Slides of similar thin-shell construction were shown followed by a discussion of the plans and specifications. This set the stage for a bid well within the job budget, with an

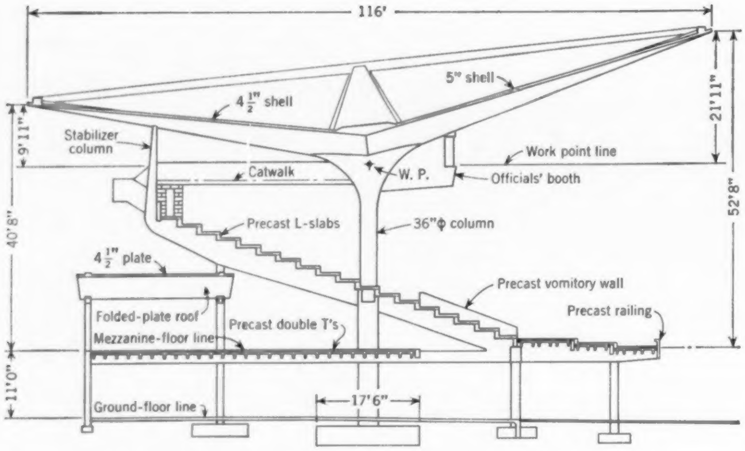


FIG. 1. Section through grandstand. Major plan dimensions are, in feet:

Mezzanine and entry level	48 x 265	Double T's spanning 30-ft bays
Ground-floor level	73 x 262	Slab on grade
Grandstand seating	84 x 265	L-slabs spanning 30-ft bays
Officials' booth	13 x 60	Two levels of steel and wood construction suspended between hyperbolic paraboloids
Grandstand high roof	116 x 300	Five hyperbolic paraboloids each 116 x 60 and 16-ft deep
Grandstand low roof	29 x 282	Multiple folded plates with 30-ft chords and 26-ft 8-in. span
Foundations, spread footings	Vary	Range up to 17 ft 6 in. square by 3 ft 6 in. thick

TABLE I. Design live loads for Scioto Downs Grandstand

Foundation soil bearing	5,000 psf
Mezzanine floor	100 psf
Upper deck	65 psf
Officials' booth:	
Upper level	100 psf
Lower level	60 psf
Hyperbolic paraboloids:	
Uniform snow loads	30 psf
Unsymmetrical snow loads	0 to 25 psf
Overload in column valleys	Water depth of 2 ft 6 in.
Officials' booth	75,000 lb
Field lights at shell edges	100 lb per lin ft
Folded plates:	
Uniform snow loads	30 psf
Unsymmetrical snow loads	15 to 45 psf

estimated price for the hyperbolic paraboloids of $3.50 per sq ft of horizontal projection.

Architectural concepts

The architects, Kellam & Foley of Columbus, were commissioned to design a grandstand and clubhouse unlike the "typical" structure. A concrete hyperbolic paraboloid roof design was selected for the grandstand to provide a spectacular appearance, eliminate bird nuisance and keep maintenance cost low. A mezzanine roof under the back of the stand is a 4-in. folded-plate concrete shell that was cast in place. The clubhouse roof is of folded-plate construction. It also was cast in place.

The design was based on a three-level plan that made use of the topography of the site. The grandstand is entered from the rear at the mezzanine level, where sellers' and cashiers' windows are located, with the offices and concession stands. Below this level is the ground floor, where sellers' and cashiers' windows are located adjacent to the track. Above the mezzanine level is the grandstand seating area, and above this is the officials' booth reached by a bridge. See Fig. 1.

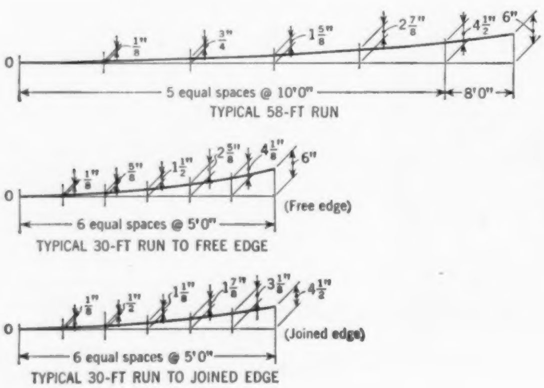


FIG. 2. Design allowance for camber in shell roof of umbrella type.

The overturning moment resulting from the tipped position of the hyperbolic paraboloids, in addition to wind loads and unsymmetrical snow loads, demanded a fully integrated structural frame. This was accomplished by making a rigid frame with the sloping beams of the bleacher area, the horizontal beams of the mezzanine, and the supporting columns. The site is underlain by dense sand and gravel. Subsurface exploration, by Greer-Jewell and Associates, indicated a probable settlement of 3/4 in. under full dead and live load. Spread footings were designed of a size to keep settlement uniform.

By increasing the shell thickness on the high side from 4 1/2 to 5 in., the paraboloids and their supporting columns were designed to sustain the overturning moment from uniform dead and live loads. A stabilizer at the low point of each paraboloid was employed for the purpose of supporting the shells under the action of wind loads and unsymmetrical live loads. These stabilizers were designed to act either as struts or ties depending upon the nature of the loading. The tension or compression force in the struts is taken by the cantilevered part of the sloped beams that are part of the bleacher. Because of the high moments in the beams of the upper deck, these beams were tapered to approximate the moment diagrams.

The major part of the reinforcing for the hyperbolic paraboloids is based almost entirely on membrane stresses. The summation of these stresses at the various shell boundaries requires either compression or tension members. Since the membrane stresses are dependent upon shell curvatures, the flat part of the shell, near the corners, will develop bending stresses resulting from a slab-like action. At these points the

shell reinforcing was increased in accordance with the procedure outlined by Alfred Parme of the Portland Cement Association in Paper 2951 (ASCE *Transactions*, vol. 123, p. 989).

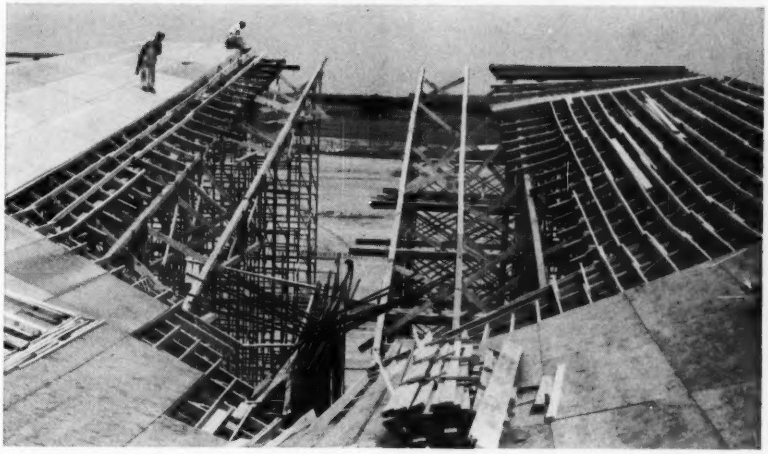
It is necessary to take the reactions from the flat-slab portions and transmit them to the tension ribs, where they must be absorbed by the bending resistance of the ribs. It is also necessary to carry reactions from the bending of these ribs back into the shell at points where the curvature is sufficient to develop the additional stresses. The temperature steel in the shell was sufficient to transmit reactions from rib bending through the shell to the column by means of imaginary compression arches within the membrane part of the shell.

Stiffening ribs do not eliminate deflections; however, they do minimize them. Accordingly, the edges of each shell were cambered to a parabolic curve, the magnitude of which was based on experience, analysis, and intuitive reasoning and judgment. The free edge of a shell was cambered more than an edge adjacent to another unit since the adjoining edges are somewhat mutually supporting. The design camber is indicated in Fig. 2.

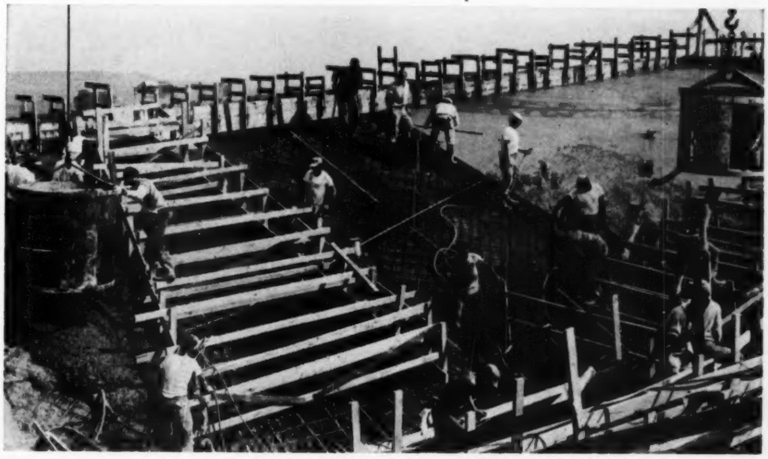
Another trouble spot with hyperbolic paraboloids of this type is where column and shell merge. Here shear and flexure stresses are high. The high stresses at these points in the shells for the Scioto Downs structure required additional concrete and reinforcing, very much as do the column capitals in flat-slab construction. This requirement was made a design feature, and resulted in a sculptured transition with varying radii of curvature in the three principal directions.

The supporting columns for the shells presented a design problem too. Minimum size had to be attained for grandstand viewing; meager technical knowledge available for this type of column action made design a challenge. Aside from the axial loads and bending moments in the column, it was necessary to consider the torsional stresses that accompany the unsymmetrical lateral loading of the roof. These torsional shear stresses were accommodated by spiral reinforcing surrounding the vertical reinforcing bars. For the deck and floors, prestressing in a specialized plant offered more uniform control and a greater re-use of forms than could be had in poured-in-place construction.

Design of connections between precast and poured-in-place concrete construction was governed by three important considerations. First it was necessary to maintain the concrete character of the structure by hiding all



Plywood on built-in-place framing over pipe scaffolding was used for the form.



Note reinforcing pattern and screed rods in view showing shell concrete being placed. In center background curing compound is being sprayed on as soon as wood floating of surface has been completed.

Double-T prestressed beams provide the floor of the mezzanine under the grandstand.

auxiliary materials for the connections. Second, all joints and openings that would allow water to penetrate had to be eliminated. Third, to maintain the lateral stability of the structure, it was necessary to provide for the thermal stresses that easily destroy the small, slender sections of precast concrete when they are permanently anchored to their supporting beams—where they were integral with the columns of the hyperbolic paraboloids. All precast decks were laterally connected to produce a stiffening diaphragm.

Precast construction

All precast concrete was made by the Concrete Masonry Corporation of Elyria, Ohio, under the direction of George Vaught. The double T's were prestressed with depressed 7/16-in. strands. To control camber, conventional reinforcing was provided so that the prestress force could be controlled. At the far corners of the box seats, these slabs were required to cantilever 12 ft 6 in. and to carry a precast railing in addition to a 100-psf live load. All units were 12 in. deep with 2 in. of concrete topping.

The upper deck of the grandstand is made up of a series of overlapping precast double-T slabs. These slabs span 30 ft, are 12 in. thick, and are prestressed. Their design was based on a zero deflection at full dead load, which was proved by a load test in accordance with the specifications.

Cast-in-place construction

Two patented systems of pipe scaffolding were used to provide support up to 65 ft high for casting the hyperbolic paraboloids. Formwork for these paraboloids consisted of a grid of 2 x 6's and 4 x 6's covered with 4-ft x 8-ft sheets of 3/4-in. plywood, which was warped and fitted to the curvature. The transition piece that joins a hyperbolic paraboloid and its supporting column of 36-in. diameter is a sculptured unit that presented a very difficult problem in forming. A steel form was considered, but the joints between sheets of metal could not be smoothed out. A Masonite liner was used and the troublesome joints smoothed out by applying a filling compound between adjoining edges. The wood form was cut in half to permit installation with column and shell forms. Start of construction was delayed. Therefore, to meet the required completion date, extra forms and falsework had to be built and some of the expected efficiency of the form system was lost.

Reinforcing steel for all poured-in-place construction was furnished and fabricated by the Pollack Steel Company. The detailing of reinforcing steel for the hyperbolic paraboloids was done by Forbes and Kugelmann, consulting engineers of Detroit, Mich. To facilitate the detailing of reinforcing bars that follow the contours of the hyperbolic paraboloids, Forbes and Kugelmann built a model of one panel of a shell at a scale of one inch to the foot.

Reinforcing steel for each beam and column was made up on the ground as a cage. The reinforcing for the hyperbolic paraboloids and the folded plate was assembled in place, and placed parallel to the direction of the principal tension stress. Several reinforcing bars of each tension rib in the hyperbolic paraboloids required a welded splice that would develop the full capacity of the bar. This was accomplished with plates and fillet welds rather than with a butt weld. Although rail steel was used in the poured-in-place construction, steel of intermediate grade was specified wherever welding was required.

A crane with a 90-ft boom, a 50-ft jib and a 3/4-cu yd bucket was used for placing most of the concrete. However, an additional crane with an 80-ft boom and a 30-ft jib was used on the hyperbolic paraboloid shells. Each crane was perched on an earth ramp to get more height with the boom, while the gooseneck jib gave it reach over the edge. The larger crane serviced the high end of the shell, and the smaller one the lower section.

Although the architects and engineers had anticipated the placing of concrete from the low point of the shell to the high point, the contractor elected to start at the high point and work down. This procedure allowed small sections of concrete to be placed in the column transition simultaneously with the concrete in the upper part of the shell, thus reducing the fluid pressure of the concrete on the curved transition forms. The transition concreting took less time than that of the shell, and enabled the contractor to continue working up in the steep part of the shell.

Concrete at the edge of the shells and at the start of the central transition was placed without any admixture. This was primarily because of the early start (5:00 a.m.) when the temperature, in the absence of sun, was in the contractor's favor. As the sun came up, a retarder (Plastiment) was added in progressively larger amounts to reduce the plastic shrinkage of the thin parts of the shells and also to reduce shrinkage in the large and massive upper parts of the column transitions. The decision to use a retarder proved to be a wise one. As the temperature rose, the humidity dropped and a drying breeze came up, yet the finishing was not affected and plastic shrinkage cracks were for the most part eliminated.

Sections of pipe on adjustable chairs were placed parallel to the "generator" lines of the shells to serve as screeds. The shell concrete was wood-floated to offer a more bondable surface for the applied roofing.

A sprayed-on curing compound was applied immediately after finishing of the shells. At the conclusion of each pour, burlap was placed on the top surface and soakers were used to keep the burlap wet for seven days.

Points of theoretical maximum deflection were determined before stripping of forms. The scaffolding was released by means of the built-in screw jack at each leg. The free edge, or outer perimeter of the shell, was released first, working progressively towards the center column. When a row of scaffolding was released, the supports for the thin concrete membrane were released before the supports for the edge members on each line of shoring.

Design of the hyperbolic paraboloids required that dead-load deflections be allowed to take place before the stabilizers at the low side of the shells were installed. Consequently, when each shell was poured, a 10-in. square hole and shear key were left in it at the junction with the stabilizer. After all the forms were removed, the stabilizer was poured through the hole in each shell.

Forms for placing closure strips between adjacent paraboloids were hung from the shells without shoring. The forms were fastened to inserts that had been set in the edges of each shell.

A plastic roofing compound (Hypalon) was sprayed on the top surface of the shells with a return at all edges. The under sides of the shells and other concrete were painted.

Other observations

At the corners of shells of this type, creep or plastic flow is a critical item often reflected in excessive deflections. The design called for the use of high early-strength cement in the shells, since its creep modulus is about half that of standard cement. During construction operations, the question arose as to whether early-strength cement should be used in conjunction with a retarder, the thought being that the property of high early strength might be lost when the retarder was used. It was decided to proceed with standard portland cement plus the retarder, and to use additional reinforcing in the ribs to reduce flexural stresses.

Although there was insufficient time for research that could be applied on this particular project, the Sika Chemical Company conducted independent laboratory tests to establish criteria for future work. The tests yielded the very interesting result that the use of a retarder such as Plastiment with high early-strength cement produced considerably higher strengths at 3 days and at 28 days than the same retarder when used with a standard cement. In other words, this retarder will delay the set of concrete for about 2 or 3 hours, but after that time its effect will subside. After 3 days the cement will attain the same strength it would have had without the retarder.

The initial deflection of the shells at each corner averaged $1\frac{1}{8}$ in. on removal of forms. This was $\frac{1}{16}$ in. more than the computed deflection. After eleven weeks, the shells had an additional deflection of $1\frac{7}{8}$ in. on the low side and $\frac{7}{8}$ in. on the high side. The greater increase in deflection on the low side is to be expected since the curvature relative to the horizontal plane is less, and thus the action of gravity is greater on these relatively flat parts.

The close correlation between the observed deflections and the computed deflections, which were based on secondary bending stresses, is significant. In this type of shell the deflection from membrane stresses alone is only $\frac{1}{16}$ of that from secondary bending stresses. In addition, deflections from the secondary reactions of the shell on the edge beams as well as on the effective cantilever arm of the edge beams, corroborates the rib shortening effect that was discussed by Mr. Parme in his paper in ASCE *Transactions* previously referred to.

On the night the racetrack opened, an interesting observation was made—there was a slight, high-frequency vibration in the mezzanine floor. This was noticed particularly when crowds of people were moving rapidly between their seats and the betting counters.

An explanation of these high-frequency vibrations in the double-T slabs in the grandstand may lie in their elastic properties. Bar joists will vibrate with a large amplitude, since their recovery is slowed down by the dead weight of the applied concrete slab and ceiling. Prestressed concrete slabs, on the other hand, vibrate with a small amplitude that gives a quivering effect. This phenomenon of quick recovery is due to the nearly constant tension in the prestressed reinforcing, which forces the slab to return to its static equilibrium after it has been depressed.

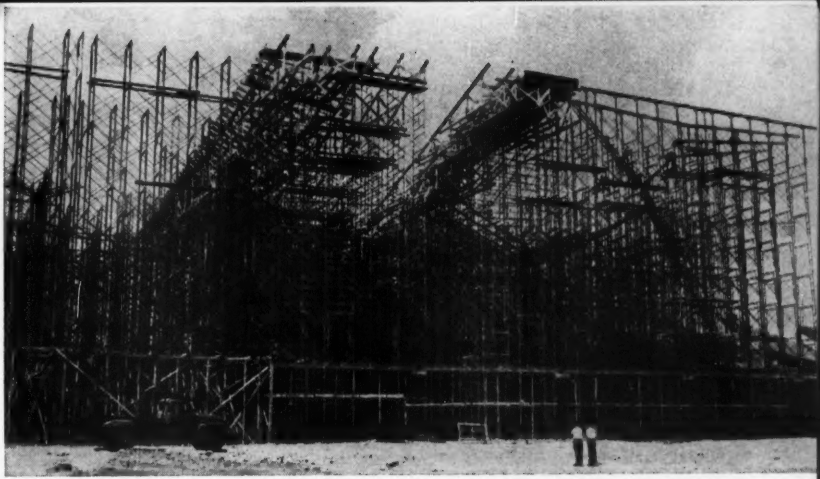
In a bar joist, on the other hand, the tensile stress in the bottom chord is appreciably reduced when the joist is at its maximum upward deflection; thus recovery to static equilibrium is under the influence of gravity only. Perhaps this can be likened to a piano wire under tension. When plucked, the wire vibrates at a high frequency, producing a tone audible to the ear. But a steel bar without tension will vibrate at a low frequency when struck, and the vibrations will not be audible.

Only three of the paraboloids have been constructed; the remaining two will be built this fall. Since the shell deflections are a function of time as well as of stress, the adjacent edges of the existing shells and the added shells will not match. To solve this problem, the edge members of the remaining shells will be prestressed sufficiently to match the deflections. The post-tensioned anchorages will not be sealed until sufficient time has elapsed for creep to produce its effect. If necessary, the tensioning will be adjusted to elevate or lower the corners as required.

The Scioto Downs grandstand is significant for both the design and the construction techniques used. On-the-job experiments with forms, reinforcing and concrete, along with the many field measurements made, should help in evaluating future construction of a similar nature.

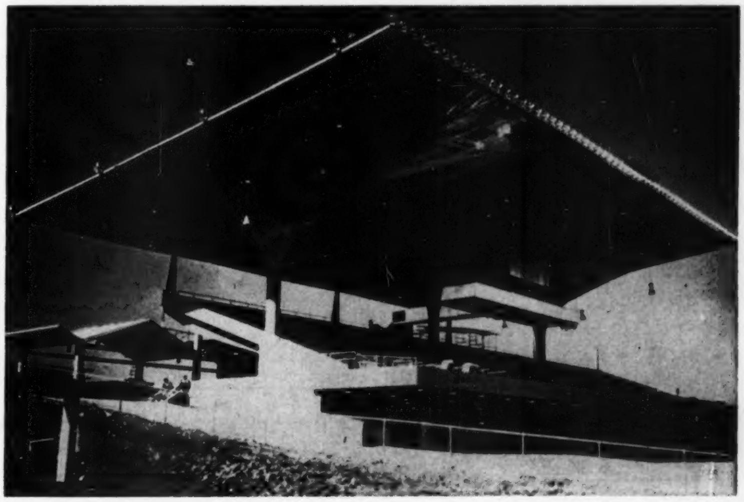
The Sheaf Construction Company of Columbus was the contractor, with Herbert Underwood as superintendent. The writer supervised the engineering design and construction.

(This article is based on the paper presented by Mr. Gensert at the ASCE New Orleans Convention, before the Construction Division session presided over by Walter L. Couse, a member of the Division's Executive Committee, and Roy G. Cappel, F. ASCE.)



Pipe scaffolding more than 60 ft high was set up to carry the hyperbolic paraboloid shell during placing of concrete.

Three sections of umbrella-type roof have been completed for the grandstand. The two remaining hyperbolic paraboloids will be constructed in the fall of 1960.



First stage of Paranoa Dam is nearing completion. Spillway-crest structure is being built in foreground. Dark-gray area on downstream slope shows where sand was used as temporary protection against drying and erosion.

A dam for Brasilia

ERIK RETTIG, F. ASCE, Consulting Engineer, Belvedere, Calif.

As a part of the grand scheme for Brasilia, the new and ultramodern capital being built for Brazil about 600 miles northwest of Rio de Janeiro, a dam is now under construction on the Paranoá River. The principal purpose of the dam is to create a lake, which with its several long branches (Fig. 1) will contribute greatly to the beauty of the spaciously planned city. To safeguard the beauty and recreational values of the lake, the permissible drawdown for power production has been set at only 0.5 m (1.6 ft) below the normal pool elevation.

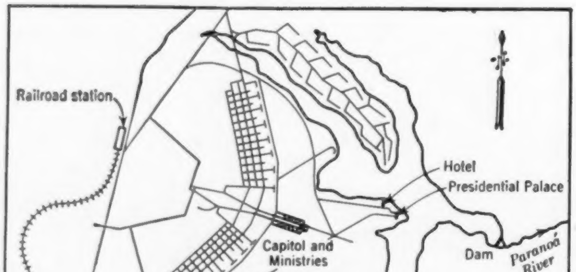
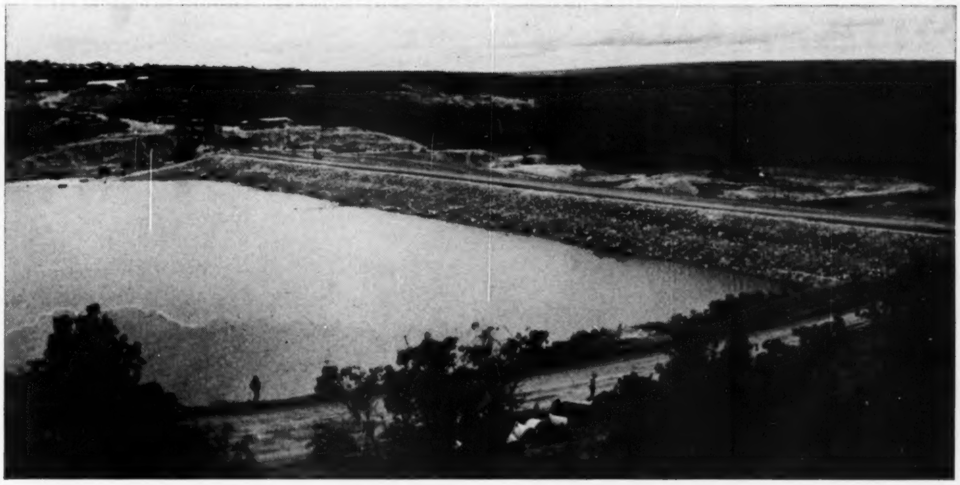


FIG. 1. A lake with several long branches will contribute to the beauty of the spaciously planned Brasilia, new capital of Brazil. An earth and rock-fill dam on the Paranoa River makes possible this attractive feature of the new city.

Of secondary importance will be the power plant, to be completed in 1961, about 0.8 mile downstream from the dam. With the large power stations at Cachoeira Dourada and Tres Marias, it will be part of a network supplying the power needs of Brasilia and the surrounding area.

The dam was originally designed as a conventional earth and rockfill structure, with a gated spillway and power intake in the ridge of the left abutment. However special conditions created problems which led to some interesting solutions, pointing out the flexibility of the original basic design.

Construction started in April 1959. Separate contractors were engaged by the Brazilian Government agency Cia. Urbanizadora de Nova Capital do Brasil (Novacap), for earthfill operations, rockfill and filters, spillway excavation and concrete work, drilling and grouting, and other parts of the



With first stage of dam completed, spillway construction progresses at north abutment—the far end.

Paranoa Dam and appurtenant structures

Dam. Length, 530 m (1,739 ft)
Height, 44 m (144 ft)
Earth fill, original design, 585,000 m^3 (765,200 cu yd)
Earth fill, final design, 801,000 m^3 (1,047,700 cu yd)
Rock fill, original design, 645,000 m^3 (843,700 cu yd)
Rock fill, final design, 405,000 m^3 (529,700 cu yd)

Spillway. Design capacity, 1,200 m^3 per sec (42,400 cfs)
Gates, three radial, 9.00 m X 6.65 m (29 ft 6 in. X 21 ft 10 in.)

Power intake. Diameter, 3 m (9 ft 10 in.), circular with transition from rectangular opening, equipped with gate and stoplogs.
Gate, 9 ft 10 in. X 10 ft 0 in., 6 fixed wheels.

Power installation, proposed. Three vertical Francis units of 9,000 kw each.

project. Such an arrangement often results in difficult problems and calls for a great deal of cooperation by all concerned. The problems have largely been overcome by a patriotic spirit of cooperation and pride in the accomplishment of the overall development plan for Brasilia, which is of great national significance.

An abundant supply of uniform and very satisfactory lateritic soil for the impermeable part of the dam was available about two miles from the right abutment. A good road for hauling it to the dam was constructed with a 6- to 7-percent down grade on an easy alignment. The earth-moving contractor has maintained ample modern equipment in good condition and has kept experienced operators on the job, making the earth moving a very efficient and economical operation.

Getting a supply of rock has presented an entirely different picture. After extensive exploration, two quarries were opened above the left bank of the river, a little over two miles downstream from the dam, generally requiring upgrade hauling. The rock is silicified and metamorphosed siltstone-sandstone, highly fractured and decomposed near the surface, and ranging to very hard and fractured at greater depths. As commonly is the case in tropical regions, weathering effects extend to depths as great as 20 to 40 ft, and much overburden has had to be removed and wasted.

Drilling and blasting have been very costly, beyond what could have been foreseen. A contributing factor is the fear of shock and vibration damage to the large glass panels in the completed presidential palace and other delicate structural details in Brasilia. Because of this, Novacap has had to restrict the blasting, and the contractor has been doing most of his drilling with hand-operated jackhammers. Difficulties and delays in getting satisfactory loading equipment and spare parts have held back progress and also have contributed to the high cost of the rock in place in the dam.

It was of great importance to impound the inflow into the reservoir during the rainy season of October 1959 to April 1960 in order to give assurance of a lake at least nearly completed when the new capital is officially dedicated. [This occurred on April 21, 1960.] Progress on the dam in the early stages, largely controlled by the rock operations, soon indicated that the full section could not be completed to a sufficient height to permit closing of the diversion conduit, and diversion through the spillway, at a sufficiently early date.

After careful study it was decided to go ahead with the construction of a "first-stage" dam section, limited in height to El. 977, sufficient to divert possible flood waters through the spillway and the power intake without overtopping the dam. As can be seen in Figs. 2 and 3, this did radially cut down the immediate need for rock. By February 1960, the first-stage section of this structure had been completed. The second-stage construc-

Completed first-stage of Paronoa Dam is seen in view looking north. Placing of second-stage fill, with filters, has just started at right.

tion to the full design section is in progress and is expected to be carried to completion by about June 1960.

The cofferdam was closed on April 21, 1959, and the river diverted through a concrete conduit that is fully capable of handling dry-season flow and moderate floods. The diversion conduit was permanently closed on September 28, 1959, with no provision for a future low-level outlet. The water in the reservoir has now reached El. 988, and work in the spillway area and on the power intake has been coordinated with progress on the dam to insure a safe discharge in case of a sudden flood. In calculating the flood possibilities, consideration was given to the fact that we are now at a peak of one of those sometimes debated 11-year cycles of storms and floods. This condition was quite clearly indicated on a 100-year record of another river in the same climatological area, which was studied to complement the rather meager data available in direct relation to the Paranoá River.

Laboratory tests and studies for the first-stage dam section indicated higher stability values for the impermeable material than had been recorded during borrow-pit exploration. This led to the belief that it might be possible to eliminate the expensive and time-consuming rock fill on the downstream face at higher elevations. A study of this possibility was made with the result that the section shown in Fig. 3 was adopted. This change is expected to bring a considerable saving in cost and time.

An ample program of tests, with installations for observing movement, pressure and seepage, is under way and is expected to yield interesting information. The steepness of the downstream earth slope, 1 vertical on 2 horizontal, may be unusual in a dam but is not without precedent in successful structures. Although tests and computations indicate an entirely satisfactory stability, special attention must be given to surface protection against excessive drying and erosion by rain water. A system of surface drains will be installed, and a dense cover of hardy grass with extensive roots will be planted. A very suitable grass has been found. A small amount of special soil and fertilizer will be added to make up for chemical deficiencies in the regular fill material.

Thanks to the flexibility of the basic design and in spite of a tight schedule and special problems, it is expected at this writing that a beautiful lake will greet those present at the inauguration of Brasilia, new capital of Brazil.

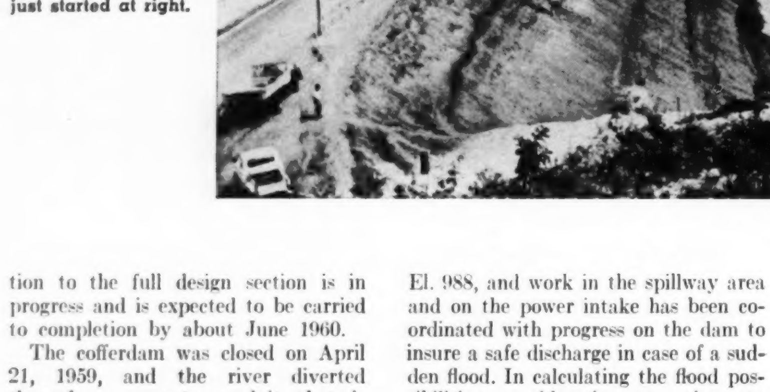
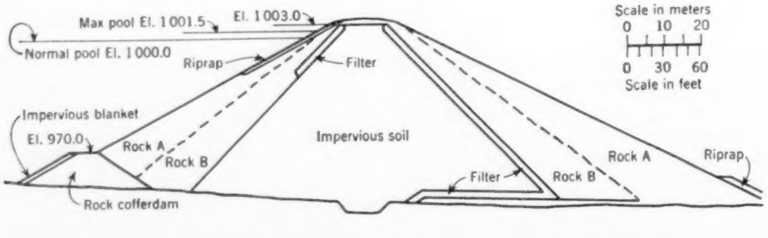


FIG. 2. Dam was originally designed as a conventional earth and rockfill structure as here shown. Later special conditions arose which led to solutions illustrating the flexibility of the basic design.

FIG. 3. Modified section of dam shows first-stage construction. Also shown is the area on the downstream side where impervious soil was substituted for rockfill. Tests and studies indicated that this substitution would be successful.



Sewer corrosion and protective coatings

C. G. MUNGER, Vice President, Amercoat Corporation, South Gate, Calif.

The use of concrete for water pipes and sewer structures has been extensive and in the great majority of cases highly successful. Corrosion problems develop only when a substantial concentration of sulfides appear as a result of a combination of most of the following circumstances:

- **A high average temperature for at least six months of the year.**
- **High concentration of organic matter.**
- **Long retention of wastes in the sewer, caused by long outfall lines, slow flow, flat grades or accumulation in such areas as pumping chambers.**
- **Significant sulfate content.**

Potent combinations of these conditions are not hard to find in the warmer areas of the United States.

With few exceptions, water has no corrosive effect on concrete, which of course is widely used as a covering to protect steel from water damage. Concrete pipe and structures often show no change after hundreds of years of service. The exceptions occur when concrete is exposed to pure, ion-free water, or to acidic water such as is encountered in industrial or swamp areas. In such cases the calcium is dissolved out of the concrete. Normally, however, concrete is improved by exposure to water and moisture.

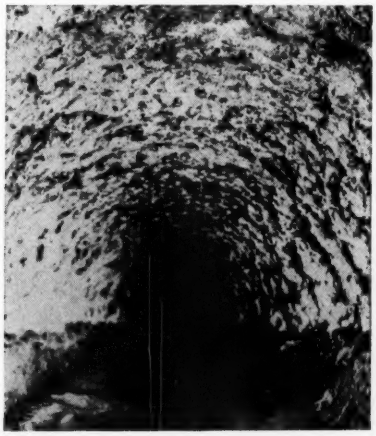
Ordinarily corrosion is thought of as an electrochemical process that attacks and destroys metals. In the majority of cases, this concept holds true. But there is another form of corrosion, almost entirely chemical in nature, which accounts for most of the damage seen in sewer systems. There is an appreciable difference between the two types of corrosion.

In the typical electrochemical reaction, water serves as an electrolyte and the more reactive areas of an iron surface go into solution quite rapidly, forming strong anodes. Electrons surrendered at the anodes pass through the metal to an adjacent area, where they concentrate within the metal to form cathodes which resist corrosive attack. The result is severe pitting and loss of metal at the anodes. This is the most common form of metal corrosion and can be observed where metals are fully immersed in sewers and subject to ordinary water reaction.

Of far greater significance is the chemical form of corrosion typified by the attack of sulfides. Under given sewage conditions, hydrogen sulfide (H_2S) is readily formed by the action of bacteria on organic matter and on sulfates in the flow. A high sulfate content in the city water supply usually increases the probability of hydrogen sulfide formation.

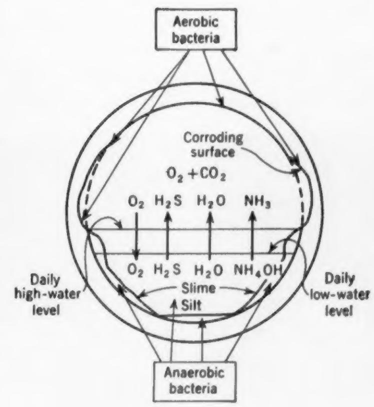
Role of bacteria

Only a few types of bacteria can bring about the formation of the destructive gas, H_2S. The organism primarily responsible is Vibrio desulfuricans, which derives its energy from the dehydrogenation of many compounds and the reduction of sulfates. This bacteria shuns oxygen, thrives on ample sulfates and organic matter, and is stimulated by warmth. Within the limits of bacterial survival, the higher the sewage temperature and the larger the Vibrio population, the



Hydrogen sulfide gas produced by anaerobic bacteria has corroded this concrete sewer pipe.

FIG. 1. The relationship between anaerobic and aerobic bacteria and their areas of corrosion in concrete pipe are shown on this sketch.



Breakdown of a tile-lined concrete sewer has resulted from sulphuric acid pentration of the tile joints.

Inner forms for concrete structures can be lined with corrosion resisting vinyl chloride sheet 4 ft × 8 ft. T-lock liner plates have here been applied to wooden forms.

greater the production of hydrogen sulfide.

These bacteria are not originally found dispersed in sewage, but are localized in the slimy growths and deposits in the sewers and on the sewer walls. They are generally classified as anaerobic.

Equally responsible for sewer corrosion is another type of bacteria, the aerobic. They require oxygen for their life processes and will oxidize sulfur compounds—such as hydrogen sulfide, elemental sulfur and thiokol—to sulfuric acid. The relationship between these two types of bacteria and the corrosion they cause in concrete pipe is shown in Fig. 1.

Anaerobic and aerobic bacteria are thus responsible for chemical corrosion of sewers in two ways. In the first, anaerobic bacteria liberate hydrogen sulfide gas, which reacts directly with metals to form metal sulfide on contact. This reaction is so rapid on copper and its alloys that such metals should not be used where sulfides are present. Cast iron, used extensively in sewers, is also highly vulnerable. If sulfide conditions are severe, tuberculation and graphitization will reduce both flow and strength. Even steel reacts with sulfides to form iron sulfide, and a steel rod under attack will decompose and swell to several times its original diameter as a result of continuing chemical conversion.

With ferrous metals the corrosion process is an endless cycle. The iron sulfide reacts with surrounding moisture and oxygen to form iron hydroxide, at the same time regenerating hydrogen sulfide, which causes further corrosion.

The second form of chemical corrosion caused by bacteria occurs through the formation of sulfuric acid by aerobic organisms. The acid reacts directly on metals to form sulfates. These are usually soluble, so that in effect the metal is dissolved away by moisture or water.

Strictly speaking, hydrogen sulfide does not affect concrete as it does metals. In sewers, however, bacteria and moisture readily oxidize hydrogen sulfide into sulfuric acid, which condenses on the arch of the sewer in droplets in a concentration that has been known to become as high as 5 percent. The effect of oxidized hydrogen sulfide on a concrete sewer is shown in an accompanying photograph.

On a limited scale, destruction of concrete in this manner has been going on for years. Today, however, the corrosion problem has become more acute because of increased population, the growing use of garbage disposal units, and the rapid expansion of industry. All these factors serve to increase the organic load and create corrosion problems where they did not exist previously.

Protective materials

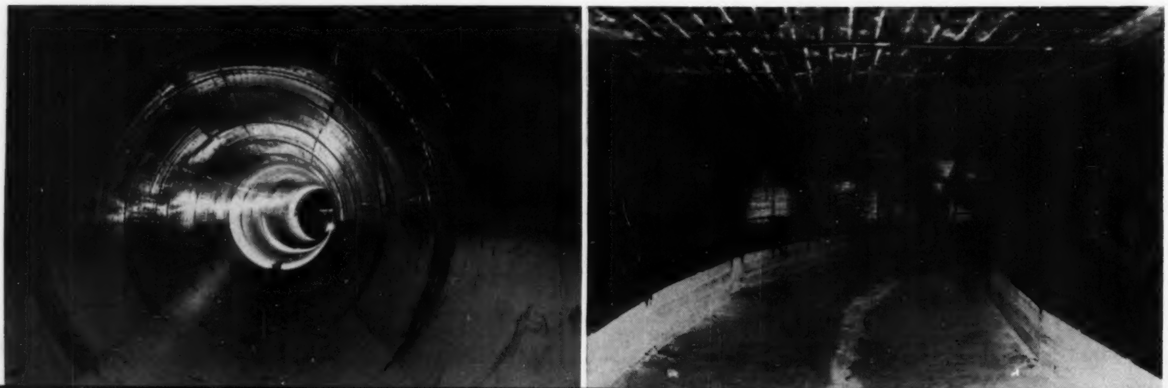
Many materials have been used as coatings with varying degrees of success, to reduce the corrosion of concrete and steel. Coatings have generally worked well on the dense surface of steel, but have proved inadequate over concrete, which is inherently porous.

Sulfur was one of the first materials considered for concrete protection because of its excellent performance in laboratory tests. It failed badly in actual sewers, however, when it encountered sulfur reducing bacteria. Asphalts and coal tars, used extensively, proved of negligible value except in areas of limited corrosion. Chlorinated rubber and sprayed vinyl coatings were a little better.

Typically, all these coatings fail on concrete because it is porous and contains many pinholes and water pockets. Since coatings that are sprayed on do not fill these imperfections, the condensed sulfuric acid in the sewer vapor penetrates the pinholes and water pockets with ease. To be effective, a coating must have not only outstanding adhesive qualities and resistance to sewage conditions, but also a sufficient thickness to cover the imperfections in the concrete without pinholing.

One material that does this is a heavy troweled vinyl applied in several coats to a thickness of about ⅛ in. Its virtually inert vinyl resins and heavy film have given excellent protection over a 15-year period under conditions where even brick and tile have been destroyed.

Vinyl chloride liner plate, with its broad range of chemical and physical properties, has found many uses. It is seen here, installed in concrete pipe of 78-in. diameter, and at right, in a cast-in-place monolithic box structure.



Recent contenders in the field of sewer coatings are the epoxy resins. Unlike vinyl resins, which are completely reacted and stable before use, epoxies may undergo reactions in place to make them form a coating. This quality has both advantages and disadvantages. Epoxies react with many materials, each of which imparts properties so different that the term "epoxy coating or lining" has no specific meaning. Of several epoxy combinations tested in sewers only one or two have proved satisfactory for more than a year. When they work, epoxies offer sound advantages: they adhere tightly to concrete, cure in place as a thick film, can be sprayed on or troweled, and form a hard, tough, impervious surface.

Clay liner plate and tile have also been used to line concrete pipe and structures, being embedded in the concrete surface. Many installations have been successful for long periods, but where corrosion is severe the method has frequently proved inadequate. The reasons for failure are basic:

1. Joints between clay areas are the weak link in the chain, and there are many lineal feet of joint in every pipe section or structure.
2. Joints between tile-lined pipe are difficult to fill with corrosion-resistant mortar.
3. When settling occurs, the tile cracks, exposing unprotected concrete areas to corrosion.
4. Often tile is porous and pinholed, allowing sulfuric acid to penetrate.

Goals for full protection

In the course of years of trial and error, certain desirable characteristics for materials designed to overcome sewer corrosion have been recognized. The perfect coating or lining must be:

1. Continuous and homogeneous in all areas of exposure, and not jointed with materials of lesser resistance.
2. Unaffected by bacteria or fungus attack.
3. Impervious to the penetration of hydrogen sulfide and other gases.
4. Inert to a wide variety of chemicals, including acids, alkalies, salts, oils and greases.
5. Unaffected by immersion, high humidity and the action of flowing water.
6. Free of oxidizing or aging effects.
7. Flexible and extensible enough to withstand surface checking of concrete and settling cracks up to 1/8 in. wide.
8. Sufficiently thick and abrasion-resistant to withstand the known abuses encountered during installation and service.
9. Firmly anchored either by extremely sound adhesion or by mechanical lock into the concrete as a part of the structure.

The search for materials to meet these criteria has ranged over many years, and in the process has isolated high polymer vinyl chloride resins as the most nearly ideal substances. They are unaffected by oxidation, water, oils, greases, acids, alkalies, salts and bacteria. In addition, they can be utilized as solvent-applied coatings or they can be molded, extruded and formed into flexible or rigid sheets. The sheets can be cast directly in concrete structures and held with a mechanical lock.

The innate toughness and high tensile strength of flexible vinyl chloride sheets enable them to withstand appreciable settling or earth changes once the lining is in service. The sheets are at least 0.060 in. thick and are made with integral T-shaped ribs on the back. See Fig. 2. These ribs become encased in concrete during the placing operation so that the sheet is locked in place so firmly that it cannot be removed without breaking the concrete. The resulting liner is impervious to bacterial action, hydrogen sulfide penetration, and reaction with any of the chemicals or waste materials normally found in sewers.

In addition, the thermoplastic nature of the vinyl chloride resins permits the sheets to be heat-welded one to another to form a continuous plastic surface. This is a major advantage since it overcomes the problem of vulnerable joints found in other types of liners.

Other than the heat-welding operation, no special procedures are required for using the vinyl chloride liner. In poured pipe, sheets of proper size are fastened around the inner form or core with light steel strapping or other suitable fastenings. The reinforcing cage is then placed and the pipe poured in the normal manner. For cast-in-place structures, inner forms are similarly lined before pouring, usually with 4-ft by 8-ft sheets which are tacked along the edges. When the forms are removed from either pipe or structure, the liner remains locked in place as an integral part of the concrete. In the completed structure or pipeline the individual sections of liner are then heat-welded together to form a continuous membrane throughout the system.

Varied uses

Because of its broad range of chemical and physical properties, vinyl chloride liner plate has found many uses, the most significant of which are:

1. To line many miles of concrete pipe ranging in size from 30 in. to 12 ft in inside diameter.
2. To line cast-in-place monolithic pipe and structures.
3. To line several miles of concrete sewer tunnel (again by fastening the sheet to the forms and casting the concrete around it).
4. To protect such complex structures as manholes, gaging and distribution chambers, siphons, pump pits and the like, where large surface areas are exposed to direct contact with oxidized hydrogen sulfide gas.
5. To protect large concrete mixing tanks from the severe corrosive effects of ferric chloride.
6. To line numerous waste chemical tanks in the steel, chemical and plating industries, where chemical effluent is treated before it enters city sewer systems.

Ten years ago, vinyl chloride sheet was a relative newcomer in the field of sewer protection. Since then experience has demonstrated that it effectively stops disintegration of metals and concrete in sewage systems. It is now protecting over 7 million sq ft of pipe and structures. Of all the methods used to prevent sewer corrosion, it appears to be the most versatile and the one coming closest to having all the properties of the ideal lining material.

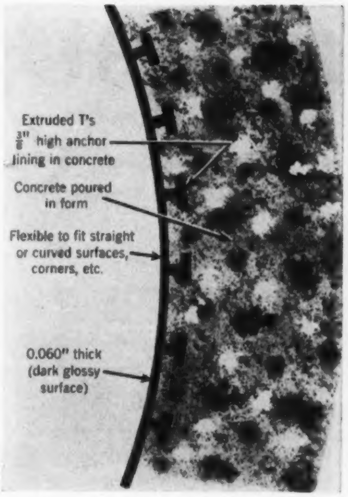


FIG. 2. The innate toughness and high tensile strength of flexible vinyl chloride sheets enable them to withstand appreciable settling or earth changes once the lining is in service. The sheets have a minimum thickness of 0.060 in. and are made with integral T-shaped ribs on the back, which become encased in concrete during the placing operation, thus locking the sheets into place.

Longest prestressed-concrete

ERIC C. MOLKE, Partner, Summers, Munninger and Molke, Consulting Engineers, Albany, N. Y.

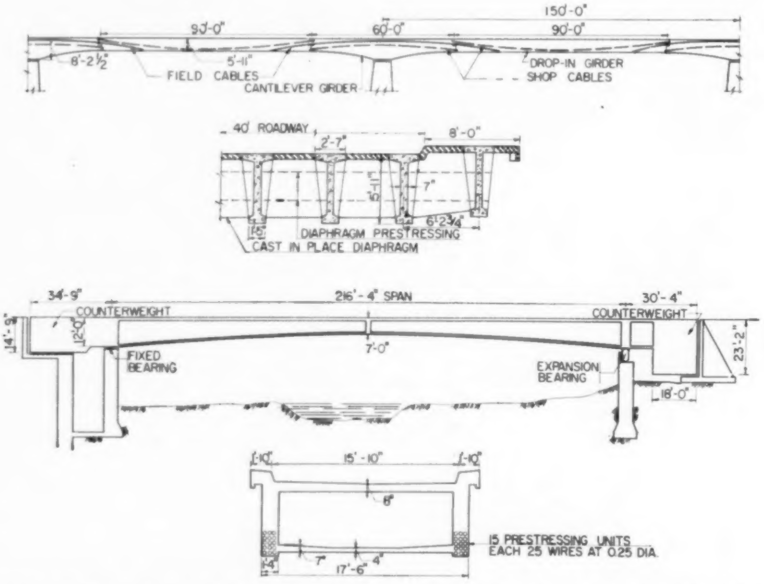
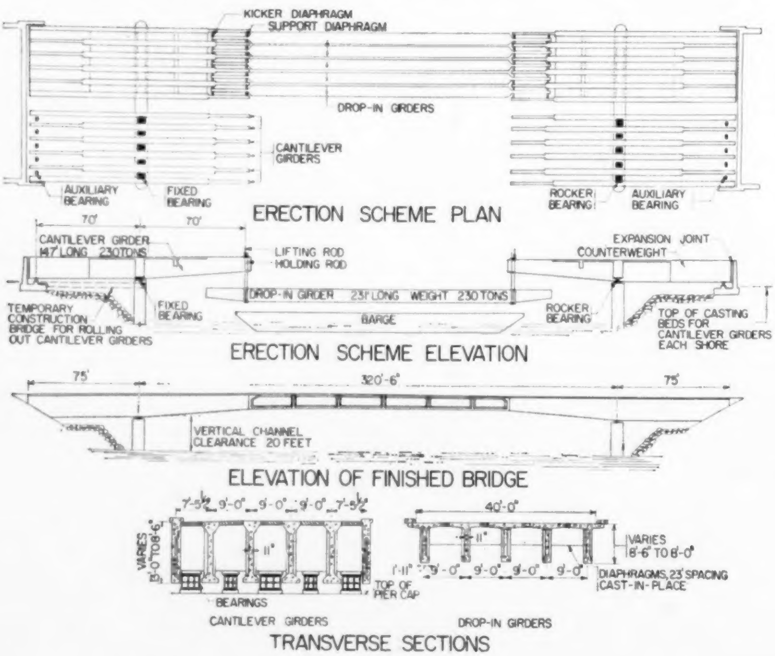


FIG. 1. Two prototypes for Oneida Lake Bridge were the Rio Grande Bridge at Laredo, Tex., and the Washington, D. C., Aqueduct Bridge.

FIG. 2. Oneida Lake Bridge consists of cantilevered girders 147 ft long over each pier and drop-in girders 232 ft long to close the span.



This country's prestressed-concrete girder bridge of longest span—320 ft—is nearing completion on the Empire State-way over Oneida Lake near Brewerton, N. Y. A ship channel 230 ft wide had to be kept unobstructed during the construction of the bridge, which led the designers to a solution with large precast girders. To arrive at a feasible and practical solution with large precast components, where high-capacity lifting equipment was not available, structural concepts had to be subordinated to construction problems. Every effort was exerted in preparing the design to provide for practical handling of the members.

Construction considered before design

The layouts of the New York State Department of Public Works called for a main span of 320 ft flanked on each side by 75-ft spans. According to this plan, the use of single-span precast girders would have resulted in units too heavy to erect. However, very few data were available on continuous precast bridges of such magnitude. Fortunately, the designers had been associated with the planning and construction of two outstanding American prestressed concrete bridges—the Rio Grande Bridge at Laredo, Tex., and the Washington, D.C., Aqueduct Bridge. See Fig. 1. Ideas from these two bridges, when combined, provided the basis for a logical solution of the problems presented by the Oneida Lake Bridge.

The Rio Grande Bridge is a continuous precast post-tensioned structure. After cantilever-beam segments 60 ft long had been placed on the piers, the span was closed by drop-in segments 90 ft long. The Washington Aqueduct Bridge is counterweighted at each end. It was cast in place and post-tensioned.

The designers of the Oneida Lake Bridge adopted the basic layout of a counterweighted main span from the Washington Bridge and the segmentation into cantilever and drop-in sections from the Laredo Bridge.

Drop-in girders, as the name implies, are usually lowered onto suitable bearings. The designers proposed a scheme of "horizontal stacking" for these girders—six cantilever girders set and blocked side by side from which the precast "drop-ins" could be lifted from a barge and suspended in their

girder bridge—320 ft—in U.S.

final position. See Fig. 2. A similar scheme for lifting long-span building girders between double columns had been applied by the designers on previous projects. (See *Journal of the American Concrete Institute*, October 1956.) The five drop-in girders fit finger-like into the spaces between the six cantilever girders on each of the two bridges. One of these three-lane bridges is for north-bound traffic and one for south-bound.

Design drawings suggested two lifting points on each drop-in girder at which it could be raised with a lifting mechanism and temporarily held suspended until all five girders were in place and aligned. A "support diaphragm" running between the noses of the cantilever girders would then be cast tightly and prestressed against the sides of the drop-in girders at their suspension points. A "kicker diaphragm," about 25 ft back from the support diaphragm, restrains the ends of each drop-in girder against the cantilever girders, Fig. 3.

The drop-in girders were given great horizontal stiffness by precasting with them a large part of the bridge slab. Transverse diaphragms 10 in. wide and 4 ft 6 in. high were spaced about 23 ft on centers.

Horizontal stacking led to the placing of the bridge bearings under the bearing diaphragms, instead of in the conventional position under the girders. Cantilever girders could thus be placed temporarily on sand jacks at piers and abutments. When all six cantilevers for one end of the bridge were in place, they would be lined up, height-wise, by releasing some sand from the jacks.

No anchor bolts or steel castings for bearings had to be set in the bottom of the girders. All five bearings could be lowered later between the girders and then set in exact position. Bearings set in place before the girders were rolled laterally along the pier, would have been an obstruction and would have been difficult to line up with their counterparts in the precast girders.

Trial calculations were made for lighter counterweights without bearings at the ends of the bridge. It was found that if the bridge ends were merely counterweighted they would deflect vertically 6 in. or more. The amount was affected by the position of the live loads and the plastic creep resulting from prestress in the girders.

Construction features specified

As many construction details as possible had to be left to the choice of the contractor. It was necessary however to coordinate the prestressing procedure with an erection sequence. A definite number of prestressing tendons of a certain pulling capacity had to be indicated since the bridge was designed without specifying a particular system of prestressing units. At the time the specifications were written, 85 tons appeared to be the largest pulling capacity that at least three manufacturers could provide. Construction drawings were prepared to show the exact location of each prestressing tendon. Additional drawings illustrated the application of three readily available prestressing systems.

Bundling of the various prestressing units in tight groups was considered, as savings could be obtained by such an arrangement of the tendons. However, it seemed probable that hollow spaces would be left in the concrete along adjoining surfaces of tightly bundled conduits. A minimum web width of 11 in. was arrived at by allowing a full 2-in. cover from web face to vertical stirrups, and a minimum horizontal space of 1½ in. between the 2⅛-in. diameter conduits of one pair of adjacent draped units. It was felt that every precaution should be taken to secure a proper concrete cover over the prestressing steel in this cold-weather area.

The design drawings showed what units had to be stressed before a girder was moved from the soffits, an intermediate stage of stressing before the drop-ins could be mounted, and the final step after the hanging of the drop-in girders. See Stages I, II, III of the longitudinal prestressing in Fig 3. Deflection curves for dead load on a cantilever girder are shown at the upper left in Fig. 3. The nose of the cantilever goes up 1¾ in. when prestressed

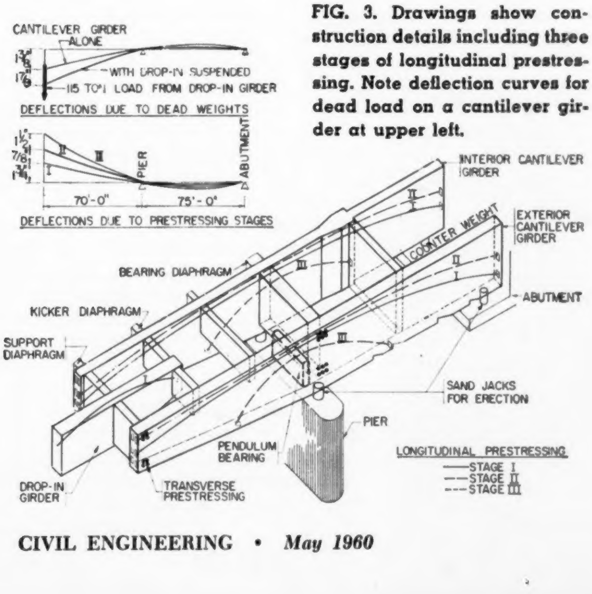


FIG. 3. Drawings show construction details including three stages of longitudinal prestressing. Note deflection curves for dead load on a cantilever girder at upper left.

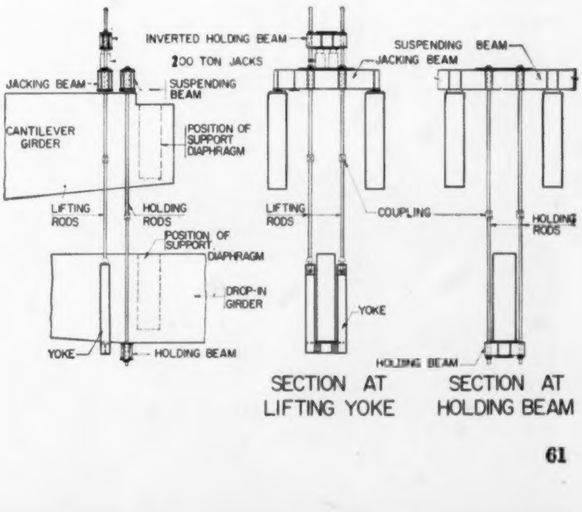
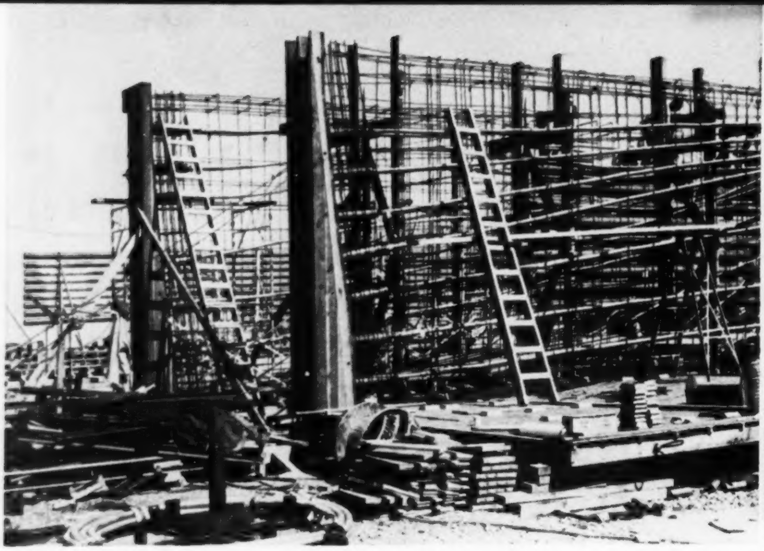
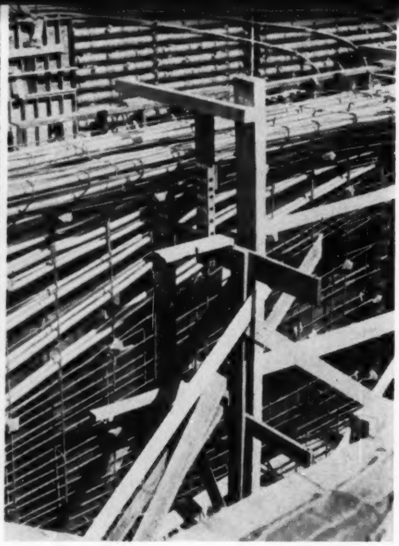
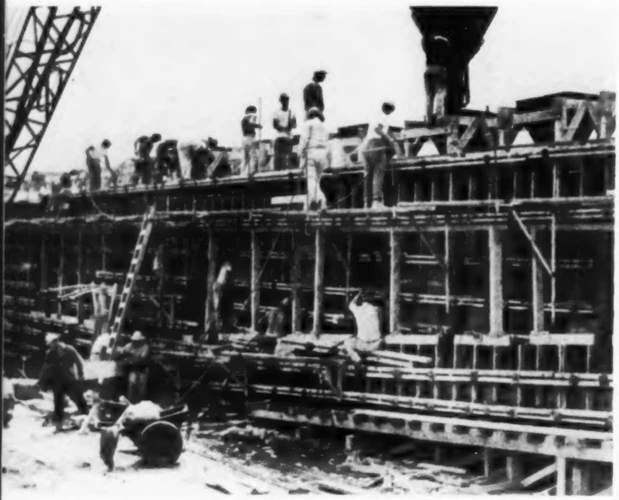


FIG. 4. Lifting mechanism for drop-in girders includes 200-ton jacks, jacking beams, and 3-in. lifting and holding rods.





The B-B-R-V system of prestressing was selected by the contractor, with tendons and encasement supplied by Joseph T. Ryerson & Son in a coil, as seen at left. The prestressing wire was played out over conveyor idlers and lifted to position by an Austin-Western hydraulic truck crane. The stressing units were set up on horizontal pipe projecting from wooden templates on one side. Stirrups were planned to carry the embedded material. Prefabricated form sections, 20 ft long, were moved up on the opposite side and supported the metal while the templates were removed and the other half of the form set.



Panel forms, built inside during the winter, had two rows of 18 x 12-in. openings 6 ft apart. Elephant-trunks guided concrete through the openings on one side—and later from the top—and vibrators were inserted from the other side. Concrete with a 28-day strength of 5,000 psi was placed at a 3½- to 6-in. slump and prestressed at 4,000 psi. It took five to six hours to place 112 cu yd of concrete in a girder.

The most extraordinary feature of the Oneida Bridge construction was the moving of the record-size precast girders. The contractor devised a simple scheme utilizing low structural-steel carriages traveling on eight skid rollers. These moved along four tracks formed by 12-in. channels in sections 20 ft long.

CONSTRUCTION

with the tendons of Stage I; this upward movement is counteracted immediately by a sag of 1⅜ in. from dead load. The prestressing of Stage II raises the nose of the cantilever another ⅞ in. When the drop-in girders are suspended, the nose sags about 1⅞ in. Finally, when the rest of the tendons are stressed, the nose goes up 1½ in.

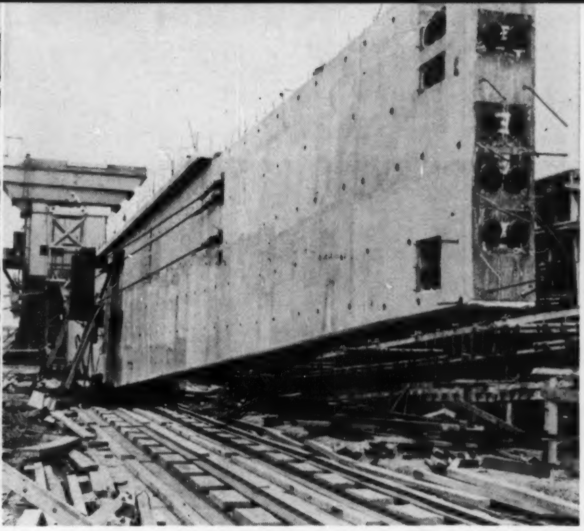
A tabulation of average concrete stresses for the calculation of creep losses was given. Pick-up points and pick-up loads were also shown on the drawings as well as the maximum reactions at the sand jacks.

In detailing the reinforcing, the designers made a great effort to anticipate the contractor's technique in preassembling the reinforcing bars, and to provide for easy placing with the prestressing units. Vertical stirrups were detailed so that they could be used to support the weight of the prestressing units.

To provide a massive appearance for the exterior cantilever girder, the walls were made straight rather than with depressed webs. To keep the weight down, Sonovoid tubes were used to form voids within the wall. The wall was made narrower also and was sufficiently flexible in the 72-ft-long cantilever end so that the sun moving from one side to the other would cause 1½ in. of movement.

Because the contractor would not be familiar with the details of the design, the construction sequence had to be specified as well as the location of the construction joints.

The girder carriage was designed for movement in several planes on shafts of 5½-in. diameter to assure an even distribution of the heavy load on to the eight skid rollers, thus always engaging a large ground area for support. Ground conditions seem the prime consideration in moving such heavy members.



Channel tracks were carried on a continuous mat of 4-in. x 12-in. transverse planking laid over 12-ft-wide pavement strips of 6-in. concrete. The beams were moved forward by hydraulic rams of 5-in. diameter having a 60-in. stroke. The exterior cantilever beams were temporarily stiffened with steel cables.

STORY in photos

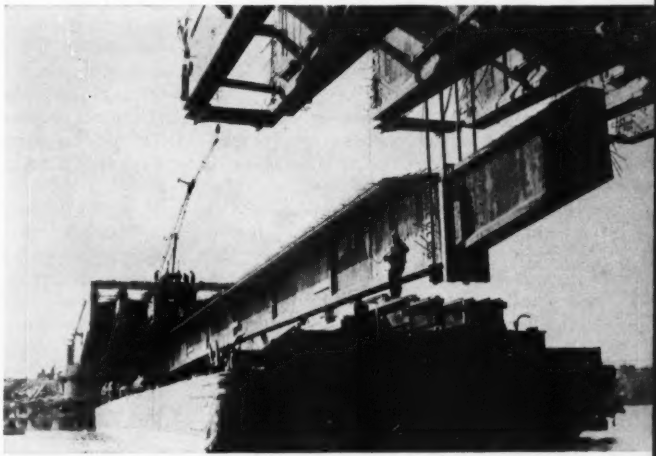
The contract for this bridge was let to Terry Contracting, Inc., of New York on May 1, 1958, for about $40 per sq ft of bridge deck, which was considerably less than previous estimates on this project for a tied steel arch.

Oneida Lake is in northern New York State, where winters are severe. By the time a batch plant had been assembled, forms built, the casting procedure programmed and approved, it was too late to cast a complete set of girders in the 1958 season. All units were cast during the summer of 1959.

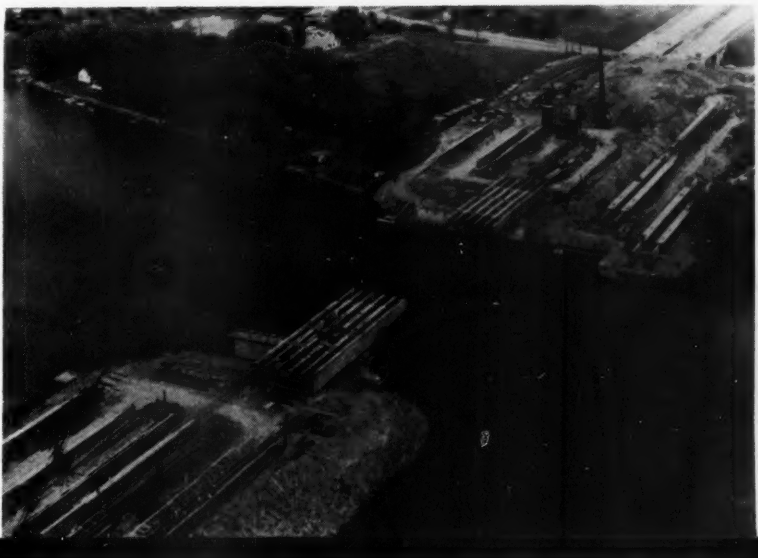
Construction procedures are illustrated in the accompanying photographs. These illustrations do not include any details of the actual prestressing. Cut-to-length ¼-in. wires with button heads came to the job preassembled into 24 to 28 wire units in a 2-⅛ in. conduit arranged for stressing by a hydraulic jack. For the drop-in girders only 12 prestressing units were used. The contractor furnished two dynamometers of 200-ton capacity which permitted excellent observations of friction losses in the long tendons.

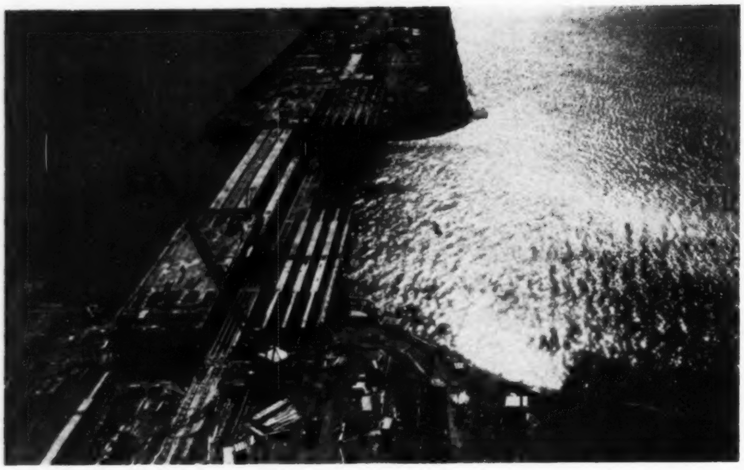
A certain amount of experimenting was done for the grouting. The performance of the grout was checked with a viscosity meter and judged by the time the grout took to empty itself out of a funnel. A maximum grout travel distance of 90 ft was originally specified, with vent openings at all high points. It was found best, however, to fill the whole length of a conduit with water and to press grout from one end against the tightly filled

Drop-in girders were pulled by winch onto a barge 200 ft long and 40 ft wide. The barge was then positioned under the bridge and hydraulic jacks, connected through a lifting yoke, were applied. Lifting and suspending rods were of high-strength steel of 3-in. diameter, the suspending rods functioning while the jacks were retracted.



Six cantilever girders were cast just back of each abutment and rolled into position, then twelve more were cast for the twin span. The casting area for the drop-in girders was at a level that permitted rolling them on to a barge. Concrete was batched and mixed in the central plant shown and delivered by truck mixers.





Counterweight at the land end of the structure had to be placed before the drop-in girders could be lifted. Note that the drop-in girders are made as wide as practical at the top to economically provide resistance to the prestressing.

conduit tubing, leaving only a small crack at the other end for the water to escape through. The 230-ft-long tendons in the drop-in girders were grouted thus from one end only.

Cross diaphragms over the bearings at the piers were cast in place. Four to six 85-kip prestressing units were diagonally draped from the top of the diaphragm to the bottom of each adjacent beam. Intermediate diaphragms also were placed. Holes through the diaphragms and the girders permitted horizontal prestressing to make the bridge a unit. Counterweight concrete was placed in two increments, the rear half before placing of the drop-in girders.

Girders were lifted from the barge to position by two 200-ton jacks with a yoke and a short jacking beam. The yoke was wedged tightly around the girder to prevent its tipping during the lifting operation. Both yoke and jacking beam were removed after the lifting operation. Holding rods worked with short holding beams, slung under the drop-in girder, and were attached on top to a long suspending beam, extending continuously across the noses of the six drop-in girders. During lifting, nuts on the holding rods were always kept hand tight to act as a safety device. While the jacks were being retracted or the rod sections removed, the holding-beam system carried the load. The holding rods had to support all the drop-in girders until the "support diaphragm" was cast between the girders. To load one girder at the nearby dock and lift it into position required one working day. After the drop-in girders were in place, the load of the structure was transferred to the permanent bearings by allowing sand to run out of the 24-in. pipe sections that had served as supporting jacks. The rest of the counterweight concrete could then be placed.

Space between the girder slabs at the top was filled with cast-in-place concrete. A bituminous concrete pavement provides a leveling and wearing course.

All girders have been completed. The approaches, the bridge deck, and the railings are being finished for a summer opening. It should be noted that the approach to the problem was original, utilizing precast members of record size, which had been gradually developed from experience in this country.

This was the first experience with prestressed concrete for the contractor, who had built some very fine long-span bridges in structural steel. All phases of the work were carried out with his own forces and engineers. He has successfully applied basic engineering principles and the know-how of steel construction to the closely related art of handling large prefabricated concrete units.

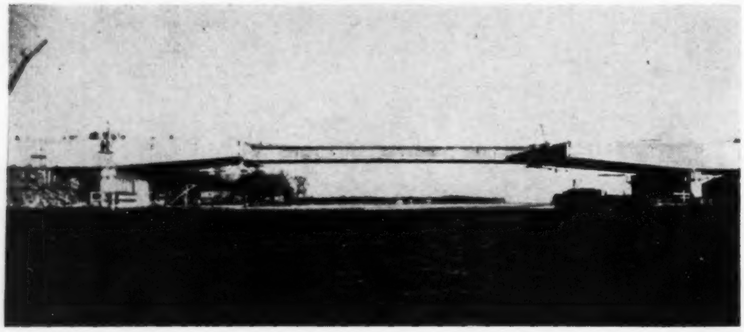
The writer's firm, having been in charge of design and supervision of construction as consulting engineers, is aware that there are possibilities for improving the design and reducing the construction cost of such bridges. Obviously any solution that will reduce the thickness of the girder webs will lighten the dead load considerably and hence reduce costs.

On the Oneida Lake Bridge, the web width was controlled by casting problems around the prestressing tendons. If fewer and larger tendons had been used, they could have been draped along the webs in single conduits instead of in pairs. This would have allowed a reduction in web width from 11 in. to 8 in. and a reduction in girder weight of at least 15 percent. An external arrangement of the tendons draped along the faces of the webs would make possible a further weight reduction but would introduce new construction and handling problems.

Casting the girders horizontally, a method considered by the contractor, would have eliminated the difficulties of dropping the concrete through the long narrow web. This also might prove to be an improvement but this technique should first be perfected on smaller girders.

The Oneida Lake Bridge is being constructed for the New York State Department of Public Works, with Henry Ten Hagen, M. ASCE, Chief Engineer; C. F. Blanchard, F. ASCE, Deputy Chief Engineer, Bridges; Earle E. Towlson, District Engineer; and E. F. Olschewske, Resident Engineer. Consulting Engineers for the Department are Summers, Munninger and Molke, with the writer and K. O. Munninger in charge of design and supervision, and R. E. Mueller as Field Engineer. Terry Contracting, Inc., is the contractor, with William Mayhew, vice president, acting as Chief Engineer, and Lloyd Monroe as General Superintendent.

One of the principal characteristics of this bridge, when seen from a good vantage point, is the slenderness ratio of 1:40, an 8-ft girder depth in the 320-ft span.



AMERICAN SOCIETY OF CIVIL ENGINEERS

Reno Convention

Official Hotels: Holiday, Mapes, Riverside, Reno, Nevada — **June 20-24, 1960**

REGISTRATION

Sunday, June 19, 2:00 to 5:00 p.m.

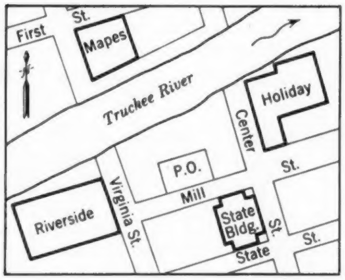
Monday through Thursday, 8:00 a.m. to 5:00 p.m.

Friday, June 24, 8:00 a.m. to 12:30 p.m.

Registration fee for members and guests, $5.00. No fee for ladies or students.

HOTEL ACCOMMODATIONS

Arrangements have been made for accommodation of visiting members at their choice of three "official hotels," the Holiday, the Mapes, and the Riverside. All are within one block of the State Building, and meetings will be held in all four buildings.



Requests for reservations should be addressed to the ASCE Housing Committee, P.O. Box 2607, Sacramento 9, Calif., preferably using the coupon on page 122. Several large motels are within a few blocks; those driving to Reno and preferring motels should so indicate on the coupon.

MONDAY MORNING, JUNE 20

Construction Division and USCOLD

9:00 a.m. — Fable Room—Mapes

Presiding: Walter G. Schulz, Member, Technical Activities Committee, USCOLD

9:00 Introduction

Francis S. Friel, Past President, ASCE, and Past Chairman, U.S. Committee on Large Dams.

9:15 Rocky Reach Dam

J. H. Boyd, Project Manager, Stone and Webster Engineering Corp., and W. N. Evans, Vice President, L. E. Dixon Co.

10:00 Table Rock Dam Concrete Placement and Cooling System

Fred Reif, Division Engr., Dam Div., Morrison-Knudsen Co., Inc.

10:45 Construction of Trinity Dam

L. B. Ackerman, Project Construction Engr., U.S. Bureau of Reclamation, Lewiston, Calif.

AUTHORS' BREAKFASTS

7:30 a.m. — Shore Room—Holiday

Each Convention day, briefing sessions are held for speakers, discussers and program officials. Admission is by invitation only.

Stewart Mitchell, Chairman of the Technical Program Committee, will preside at these sessions.

Structural Division

9:00 a.m. — Tahoe Room—Holiday

9:00 Relaxation of High-Strength Bolts

W. H. Munse, Prof. of Civil Eng., Univ. of Illinois, Urbana.

10:00 Tests of Large Bolted Joints

J. L. Rumpf, Assoc. Prof. of Civil Eng., Drexel Inst. of Tech., Philadelphia, Pa., and L. S. Beedle, Chairman, Structural Metals Div., Lehigh Univ., Bethlehem, Pa.

11:00 Revision of Bolted Joint Specifications

T. R. Higgins, Director of Eng., A.I.S.C., New York, N.Y.

Sanitary Engineering Division

9:00 a.m. — Gourmet Room—Riverside

Multiple Use Concepts of Water Resources Problems

Presiding: H. Loren Thompson, Consulting Engr., Portland, Oregon

9:00 Fisheries Statistics as a Tool in Evaluating Validity of Claims of Pollution

Roger Tellefson, Consulting Biologist, Toledo, Oreg.

9:45 Sanitary Engineering and Economic Aspects of the Opening of East Bay Municipal Utility District's Water Supply Reservoirs to Recreational Uses

John W. McFarland, Gen. Manager, East Bay Municipal Utility Dist., Oakland, Calif.

10:45 Some Economic Considerations in Water Planning

P. H. McGauhey, Director, Sanitary Eng. Research Lab., Univ. of Calif., Richmond.

Surveying and Mapping Division

9:00 a.m. — Veterans' Room—State Bldg.

Presiding: Oliver R. Bosso, Member, Exec. Committee

9:00 Measurement of Permanent Displacement of the Earth's Surface by Faults and Earthquakes

William F. Malnate, Capt., U. S. Coast and Geodetic Survey.

9:30 New Methods in Cadastral Surveying

Franklin K. Van Zandt, Cartographic Engr., Photogrammetry, U.S. Bureau of Land Management, Washington, D.C.

10:00 Short Cuts in the Location, Right-of-Way Descriptions, and Design of Roads through Use of Photogrammetry and Electronic Computation

Charles O. Greenwood

Waterways and Harbors Division

9:00 a.m. — Bonanza Room—Mapes

Sponsored by Committee on Navigation and Flood Control Facilities

9:00 Paper on dredging by representative of Jahncke Service, Inc.

9:30 Flood Control Features of Proposed Oroville Dam, California

J. I. Burns, Chief, Eng. and Operations Sect., Div. of Design and Construction, State Div. of Water Resources, Sacramento, Calif.

10:00 Barkley Lock Project

Joe A. Judge, Tecon Corp.

WELCOME LUNCHEON

Monday, June 20

12:15 p.m. Garden Room—Riverside

Speaker: HON. GRANT SAWYER, Governor, State of Nevada

Subject: Industrial Potential of Nevada

Presiding: FRANK A. MARSTON, President, ASCE

Toastmaster: HOWARD B. BLODGETT, Co-Chairman, Reno Convention Committee

Greetings: CLAIR A. HILL, President, Sacramento Section
VERNON M. MEISER, President, Nevada Branch

All members, guests and ladies are invited to attend. Tickets available until 11:00 a.m. Monday. Per plate, $3.00.

MONDAY AFTERNOON

JUNE 20

Power Division and USCOLD

2:00 p.m. Fable Room—Mapes

***Presiding:* M. P. Aillery, Chairman, Exec. Committee, Power Division**

2:00 Oroville Dam

W. G. SCHULZ, and D. P. THAYER, and J. J. DOODY

2:45 Upper American River Project

C. H. SPENCER and D. S. CULVER

3:30 Design Considerations Relative to Operation of Mammoth Pool Dam and Reservoir

R. W. SPENCER and T. M. LEPS

Sanitary Engineering Division

2:00 p.m. Gourmet Room—Riverside

Air Pollution

***Presiding:* Randolph H. Dewante, Coordinator, Reno Sanitary Eng. Div. Program**

2:00 Air Pollution Control and Research at Kaiser Steel Corp., Fontana, Calif.

J. H. SMITH, Director, Air Pollution Control and Research, Kaiser Steel Corp., Fontana, Calif.

2:40 Air Pollution Control and Research in the West Coast Oil Industry

R. T. MAPSTON, Air Pollution Control Engr., Richfield Oil Corp., Wilmington, Calif.

3:30 Air Pollution Control Requirements for Industry

BENJAMIN LINSKY, Air Pollution Control Officer, Bay Area Air Pollution Control Dist., San Francisco, Calif.

4:10 Aesthetic Values in Air Pollution Control—Reducing Sewage Plant Odors in a High-Type Residential Area

WILLIAM S. HYDE, Supervising Engr., Div. of Water and Sewers, City of Sacramento, Calif.

Structural Division

2:00 p.m. Tahoe Room—Holiday

2:00 Economy of High-Strength Steels in Bridge Construction

L. C. HOLLISTER, Projects Engr., and R. D. SUNBURY, Assoc. Bridge Engr., Calif. Div. of Highways, Sacramento.

3:00 Test of a Steel Plate Girder

DESI D. VASARHELYI, Assoc. Prof. of Civil Eng., Univ. of Washington, Seattle.

4:00 High-Strength Deformed Bars for Concrete Reinforcement

EIVIND HOGNESTAD, Manager, Structural Development Sect., Portland Cement Assn., Chicago, Ill.

Surveying and Mapping Division

2:00 p.m. Veterans' Room—State Bldg.

***Presiding:* Oliver R. Bosso, Member, Exec. Committee**

2:00 Wendover, Utah, gets an Original Subdivision Survey—80 Years Later

ALTON H. SORENSEN, Engr., Caldwell & Richards, Salt Lake City, Utah.

2:45 Large-Scale Mapping of Lake Powell

CLYDE D. GESSEL, Civil Engr., U.S. Bureau of Reclamation, Salt Lake City, Utah, and D. H. RUTLEDGE, Asst. to Pacific Region Engr., U.S. Geological Survey, Sacramento, Calif.

Waterways and Harbors Division

2:00 p.m. Bonanza Room—Mapes

Symposium on Sacramento Deep-Water Ship Channel Project

Sponsored by Committee on Ports and Harbors, and Committee on Navigation and Flood Control Facilities

2:00 Functional Planning

AMALIO GOMEZ, Chief, Planning Branch, Sacramento Dist., Corps of Engineers.

2:30 Technical Design and Model Studies

HARRY DETTMER, Chief, Design Branch, Sacramento Dist., Corps of Engineers.

3:00 Construction of Ship Channel

O. H. HART, Chief, Construction-Operations Div., Sacramento Dist., Corps of Engineers.

3:30 Development of Port and Terminal Facilities

MEL SHORE, Port Engr., Sacramento-Yolo Port Dist., Sacramento, Calif.

TUESDAY MORNING

JUNE 21

Highway Division

9:00 a.m. Tahoe Room—Holiday

***Presiding:* Edward T. Telford, Member, Committee on Geometrics of Highway Design**

9:00 SYMPOSIUM on Design Features of the Interstate Highway System through Sparsely Populated Areas

GEORGE WILLIAMS, Asst. Commissioner, U.S. Bureau of Public Roads, Washington, D.C.

OSCAR T. LYON, JR., District Engr., Arizona Highway Dept., Safford.

PAUL G. MARTIN, Consulting Engr., Burgwin and Martin, Topeka, Kans.

10:00 Highways through Highly Developed Agricultural Lands

R. H. KENYON, Chief Engr. of Plans and Contracts, Washington Dept. of Highways, Olympia, Wash., and RUDOLF HESS, Asst. Chief Right-of-Way Agent, Calif. Div. of Highways, Sacramento.

11:00 LTS Design of Continuously Reinforced Concrete Pavement

W. B. LEDBETTER, Senior Eng. Asst., Texas Highway Dept., Austin.

Sanitary Engineering Division

9:00 a.m. Gourmet Room—Riverside

Water Supply Treatment and Distribution

***Presiding:* Walter F. Gassman, Kennedy Engrs., San Francisco, Calif.**

9:00 More Water for California's Capital City

WILLIAM W. AULTMAN, Vice President, James M. Montgomery, Consulting Engr., Pasadena, Calif.

9:40 Reno Water Supply with Emphasis on Instrument Control of Chlorine Dosage

JOHN SAIBINI, Water Supt., Sierra Pacific Power Co., Reno, Nev.

10:30 **The Influence of Agricultural Pesticides on Surface and Ground Waters**

JACK DREESSEN, National Agricultural Chemicals Assoc., Washington, D.C.

11:15 **Discussion of Influence of Agricultural Fertilizers, Weedicides, Herbicides and Insecticides on Surface and Ground Waters**

Soil Mechanics and Foundations Division and USCOLD

9:00 a.m. Garden Room—Riverside

Session on Earth Dams

Presiding: T. M. Leps, Vice Chairman, Executive Committee, Soil Mechanics and Foundations Div.

9:00 **Tuttle Creek—a Dam of Rolled Shale and Dredged Sand**

K. S. LANE, and R. G. FEHRMAN

9:45 **Madison Canyon Slide**

K. R. BARNEY, Maj. Gen., U.S. Army Engr. Div., Omaha, Nebr.

10:30 **An Engineering Appraisal of the August 1959 Earthquake Damage to Herbgen Dam**

C. H. KIRK

Structural Division

9:00 a.m. Fable Room—Mapes

9:00 **Shear and Diagonal Tension in Concrete**

BORIS BRESSLER, Assoc. Prof., Eng. Materials Lab., Univ. of Calif.

10:00 **Strength of Long Concrete Columns**

J. J. KOZAK, Senior Bridge Engr., Calif. Div. of Highways, and FRANK BARON, Prof. of Civil Eng., Univ. of Calif.

11:00 **Loads and Stresses in Ultimate Load Design**

PHIL M. FERGUSON, Prof. of Civil Eng., Univ. of Texas, Austin

Waterways and Harbors Division

9:00 a.m. Bonanza Room—Mapes

Symposium on Marina Development

Sponsored by Committee on Ports and Harbors

9:00 **Small-Craft Harbors**

JAMES DUNHAM, Div. Engr., California Div. of Small-Craft Harbors, Sacramento.

9:30 **Marina Development on Lake Tahoe**

10:00 **Development of Light-Draft Coastal Harbors**

REUBEN JOHNSON, Chief, Planning Branch, San Francisco Dist., Corps of Engrs.

GENERAL MEMBERSHIP LUNCHEON

Tuesday, June 21

12:15 p.m. Sky Room—Mapes

Speaker: HON. GEORGE D. CLYDE, F. ASCE, Governor, State of Utah

Subject: The Engineer in Politics

Presiding: FRANK A. MARSTON, President, ASCE

Toastmaster: R. ROBINSON ROWE, Co-Chairman, Reno Convention Committee

All members, guests and ladies are welcome. Tickets available until 9:00 a.m. Tuesday. Per plate, $3.00.

TUESDAY AFTERNOON

JUNE 21

Highway and Construction Divisions

2:00 p.m. Tahoe Room—Holiday

Presiding: Milton Harris, Construction Engr., Div. of Highways, State of Calif.

2:00 **Constructing Facilities in Hawaiian Soils**

WAYNE E. DUNCAN, Chief, Foundations, Materials and Surveys Branch, Corps of Engineers, Honolulu District, Hawaii.

3:00 **Surface Irregularities on Approaches to Highway Bridges**

CHARLES W. JONES, State of Calif. Div. of Highways.

3:45 **Panel Discussion—Highway Construction in the Sierras**

ALAN HART, Dist. Engr., Calif. Div. of Highways, Marysville.

Speaker from Nevada Highway Dept.

Hydraulics Division and USCOLD

2:00 p.m. Garden Room—Riverside

Presiding: Maurice L. Dickinson, Vice Chairman, Exec. Committee, and Harold Pratt, Member, Hydraulic Structures Committee, Hydraulics Div.

2:00 **Hydraulic Design of Hollow-Jet-Valve Stilling Basin**

ALVIN J. PETERKA, Hydraulic Lab., U.S. Bur. of Reclamation, Denver, Colo.

3:15 **Outlet Works for Courtright and Wishon Dams**

J. BARRY COOKE and J. E. SCHUMANN, Pacific Gas & Electric Co., San Francisco, Calif.

4:00 **Smooth-Bore Valves**

ROSS L. MAHON, Retired, Carmel, Calif.

Soil Mechanics and Foundations Division

2:00 p.m. Gourmet Room—Riverside

Session on Grouting

Presiding: R. E. Davis, Chairman, Committee on Grouting

2:00 **Introductory remarks**

WALTER PRICE, Secretary, Committee on Grouting.

2:15 **Grouting of Granular Materials**

J. C. KING, and E. G. W. BUSH

3:00 **Grouting at Fort Campbell Theater Building**

B. E. CLARK

3:45 **Grouting to Prevent Vibration of Machinery Foundations**

J. P. GNAEDINGER

4:30 **Research in Cement Grouting**

T. B. KENNEDY

Structural Division and Structural Engineers Association of California

2:00 p.m. Fable Room—Mapes

Presiding: William T. Wheeler, Chairman, Seismology Committee, Structural Engrs. Assoc. of Calif.

2:00 **Panel Discussion of Revised Seismic Code Developed by the State Seismology Committee of the Association**

Base Shear and Shear Distribution

Period Determinations for Buildings and Structures

Effect of Overturning

Diaphragms

Drift in Buildings

Effect at Offsets and Setbacks in Building Structures

Horizontal Torsional Effects on Buildings

Panelists:

HERMAN FINCH, Supervising Structural Engr., Div. of Architecture, Sacramento, Calif.

R. W. BINDER, Chief Engr., Bethlehem Pacific Coast Steel Corp., Los Angeles, Calif.

STEPHENSON B. BARNES, Consulting Structural Engr., Los Angeles, Calif.

John A. Blume, John A. Blume & Assocs., San Francisco, Calif.

George Arthur Sedgwick, Ellison, Sedgwick & Assocs., San Francisco, Calif.

Waterways and Harbors Division

2:00 p.m. Bonanza Room—Mapes

Sponsored by Committee on Regulation and Stabilization of Rivers and Committee on Coastal Engineering

2:00 Bank and Levee Protection in the Sacramento and San Joaquin River Basins

Raymond W. Barsdale, Chief, Levees and Channels, Design Sect., Sacramento Dist., Corps of Engineers.

2:30 Maintenance of Navigable Depths in Sacramento and San Joaquin River Basins

Ronald H. Thompson, Chief, Operations Branch, Sacramento Dist., Corps of Engineers.

3:00 Progress Report on Russian River Stabilization Works

Israel H. Steinberg, Asst. Chief, Planning and Reports Branch, Engineering Div., San Francisco Dist., Corps of Engineers.

NEVADA ALUMNI DINNER

Tuesday, June 21

Hidden Valley Country Club

Cocktails 6:30 p.m.
Dinner 7:30 p.m.

A wonderful opportunity for the renewal of past friendships and the making of new ones, not only for Nevada CE grads, but for other gregarious people and kindred spirits.

Guest of Honor: Prof. Emeritus Horace P. Boardman, F. ASCE

Toastmaster: Charles R. Poppe, M. ASCE

All members, their wives and friends are invited to attend. Tickets on sale at Advance Registration Desk until 3:00 p.m. Monday. Per plate, $5.75, including transportation.

WEDNESDAY MORNING JUNE 22

General Business Meeting

9:00 a.m. Auditorium—State Bldg.

President's Annual Address

Conditions of Practice Session

10:00 a.m. Auditorium—State Bldg.

Presiding: Paul L. Holland, Chairman, Department of Conditions of Practice

First Session: Review of Accreditation Policies

10:00 Impact of Accreditation Policies on Small Engineering Schools

A. Diefendorf, Dean, School of Eng., College of the Pacific, Stockton, Calif.

10:30 Problems in Establishing a New Engineering School

Norman J. Castellan, Prof. in Charge of Civil Eng., Sacramento State College, Sacramento, Calif.

Second Session: Attitude of Public Agencies Toward Activity of Public Employees in Professional Societies

Moderator: M. J. Shelton, Chief Engineer, San Diego Office, Koebig and Koebig

11:00 Report from Los Angeles Section

Ray D. Spencer, Vice President, Koebig and Koebig, Los Angeles.

11:15 Report from Colorado Section

Harold Martin, Head, Hydraulic Lab., U.S. Bureau of Reclamation, Denver, Colo.

11:30 Report from Sacramento Section

R. Robinson Rowe, Principal Bridge Engr., California Div. of Highways, Sacramento, Calif.

11:45 Report from Hawaii Section

Wayne E. Duncan, Civil Engr., Corps of Engineers, Honolulu, Hawaii.

GENERAL MEMBERSHIP LUNCHEON

Wednesday, June 22

12:15 p.m. Shore Room—Holiday

Speaker: Ralph A. Tudor, F. ASCE, President Tudor Engineering Co., San Francisco, Calif.

Subject: Partnership Power—Policy and Politics

Presiding: Frank A. Marston, President, ASCE

Toastmaster: F. W. Panhorst, F. ASCE, Past Director, Sacramento, Calif.

All members, guests and ladies are welcome. Tickets available until 9:00 a.m. Wednesday. Per plate, $3.00.

CONSTRUCTION AND HIGHWAY DIVISIONS JOINT FIELD TRIP

Wednesday, June 22

8:30 a.m. to 5:00 p.m.

Buses will load on State Street near entrance to State Building. Inspection of Interstate and other state highways in Nevada and California, reaching Donner Summit, Squaw Valley and Lake Tahoe en route. Guides furnished by California Division of Highways and Nevada State Highway Department.

No-host luncheon en route. Tickets must be purchased by 5:00 p.m. Tuesday.

SANITARY ENGINEERING DIVISION FIELD TRIP

Wednesday, June 22

2:00 to 5:30 p.m.

Buses will load on State Street near entrance to State Building. Inspection of Winter Olympics Sewage Treatment Plant in Squaw Valley, California, 45 miles southwest of Reno.

Conducted by Walter F. Gassman, Kennedy Engineers, San Francisco.

Tickets must be purchased by 10:00 a.m. Wednesday.

WEDNESDAY AFTERNOON JUNE 22

Hydraulics Division

2:00 p.m. Tahoe Room—Holiday

Session on Flood Control

Presiding: Maurice L. Dickinson, Vice Chairman, Exec. Committee, and Francis G. Christian, Member, Flood Control Committee

2:00 Flood Plain Regulations to Avoid Flood Damage

James E. Goddard, Chief, Local Flood Relations Branch, Tenn. Valley Authority, Knoxville.

3:15 Cost Allocation of Multiple-Purpose Projects in the Central Valley of California

Amalio Gomez, Chief, Planning Branch, Corps of Engineers, Sacramento, Calif.

4:00 Functional Design of High-Velocity Flood Control Channels

Albert P. Gildea, Chief, Hydraulic Design Sect., Corps of Engineers, Los Angeles, Calif.

Irrigation and Drainage Division

2:00 p.m. Bonanza Room—Mapes

Water Desalinization Session

Sponsored by the Task Group on Water Quality

Presiding: N. A. Christensen, Member, Exec. Committee

2:00 **Outlook for Economic Use of Fresh Water from the Sea**

SAMUEL B. MORRIS, Consulting Engr., Los Angeles, Calif.

2:30 **Desalinization of Brackish Waters by the Electrodialysis Process**

DAVID B. WILLETS, Supervising Hydraulic Engr., Southern Calif. Dist. Office, Calif. Dept. of Water Resources, Los Angeles, Calif.

3:00 **The Sea Water Conversion Plant Planned for San Diego, Calif.**

MAURICE B. ANDREW, Supervisor, Applied Nuclear Eng. Unit., Dept. of Water Resources of Calif., Sacramento.

Soil Mechanics and Foundations Division

2:00 p.m. Fable Room—Mapes

Session on Grouting

Presiding: S. J. Johnson, Member, Exec. Committee

2:00 **Investigation of Sand-Cement Grouts**

J. M. POLLATTI

2:30 **Design and Construction of Grouting Cutoff—Rocky Reach Hydroelectric Power Project**

W. F. SWIGER, and J. H. BOYD

3:00 **Effects of Flowing Water and Stratification on Grouting Efficiency**

R. A. SWIFT and R. H. KAROL

3:30 **Grouting of Deep Shafts and Underground Reservoirs**

JOSEPH RAMOS, and WAYNE HOWER

THURSDAY MORNING

JUNE 23

Construction Division and Sanitary Eng. Division

9:00 a.m. Fable Room—Mapes

Presiding: O. C. Struthers, Member, Committee on Programs at Technical Sessions, Construction Div.

9:00 **Hyperion Outfall Sewer, City of Los Angeles—Completion of Work**

I. F. MENDENHALL, representing Hyperion Engineers, a Joint Venture of the Calif. Corporations of Daniel, Mann, Johnson & Mendenhall; Holmes & Narver, Inc.; and Koebig & Koebig.

9:45 **Deep-Water Structures in Prestressed Concrete**

ROBERT N. BRUCE, Raymond International Inc.

10:30 **The Projected Construction Program for the California Water Facilities**

WALTER G. SCHULZ, Chief Engr., Div. of Design and Construction, Dept. of Water Resources, State of Calif.

Hydraulics Division

9:00 a.m. Veterans' Room—State Bldg.

Session on Tidal Hydraulics

Presiding: Maurice L. Dickinson, Vice Chairman, Exec. Committee, and Irvin M. Ingerson, Member, Tidal Hydraulics Committee

9:00 **A Statement of the Problems of the Sacramento-San Joaquin Delta in California's Water Development Program**

IRVIN M. INGERSON, Asst. Div. Engr., Calif. Dept. of Water Resources, Sacramento.

9:30 **Experience in Controlling Salinity Intrusion into a Tidal Estuary—Protecting Water Quality of Central Valley Project Diversions from Sacramento-San Joaquin Delta in California**

DON HEBERT, Hydraulic Engr., U. S. Bureau of Reclamation, Region 2, Sacramento, Calif.

10:15 **Predicting the Water Quality of Future Diversions from Sacramento-San Joaquin Delta**

HERBERT W. GREYDANUS, Supervising Hydraulic Engr., Calif. Dept. of Water Resources, Sacramento, Calif.

Irrigation and Drainage Division

9:00 a.m. Bonanza Room—Mapes

Water Desalinization Session

Sponsored by the Task Group on Water Quality

Presiding: P. H. McGauhey, Chairman, Task Group on Water Quality

9:00 **Quality Requirements of Water for Irrigation**

MILTON FIREMAN, Research and Extension Specialist, Univ. of Calif., Davis.

9:30 **Tolerance of Plants to Salinity**

LEON BERNSTEIN, Plant Physiologist, U. S. Salinity Lab., USDA, ARS, Riverside, Calif.

10:00 **Leaching Requirements in Use of Saline Water for Irrigation**

RAYMOND HILL, Consulting Engr., Leeds, Hill & Jewett, Los Angeles, Calif.

Pipeline Division

9:00 a.m. Nevada Room—Mapes

9:00 **Fundamentals of Cathodic Protection**

JACK W. PIERCE, Supervisor of Design Engrs., Southern Calif. Gas Co., Los Angeles.

Symposium on Steel Pipe Coatings

9:30 **Coal Tar**

H. E. TILLMAN, Koppers Co., Los Angeles, Calif.

Asphalt

D. J. MCNUTT, Douglas Oil Co., Los Angeles, Calif.

Somastic

H. F. LYMAN, Pipe Linings, Inc., Wilmington, Calif.

Pressure-Sensitive Tape

WILLARD MCCAY, Barnes & Delaney Co., Los Angeles, Calif.

Cement Mortar

C. E. LAMAR, Southern Pipe and Casing Div. of U. S. Industries, Azusa, Calif.

10:30 **Construction of 90-In. Ocean Outfall Sewer**

LESTER A. HAUG, Div. Engr., Industrial Waste Div., Los Angeles County Sanitation Dist.

11:00 **Electronic Computer Applied to Pipeline Problems**

RAY BERMAN, Bendix Computer Div., Bendix Aviation Corp., Los Angeles, Calif.

Power Division

9:00 a.m. Tahoe Room—Holiday

Presiding: John F. Bonner, Member, Exec. Committee

9:00 **Glen Canyon Power Plant**

SAMUEL JUDD

9:40 **Wanapum Dam**

C. K. WILLEY

10:15 **Design and Construction of Cherry Power Project of the City of San Francisco**

W. F. GETTS and O. L. MOORE

11:00 **Power Features of the California Water Plan**

D. P. THAYER and J. J. DOODY

GENERAL MEMBERSHIP LUNCHEON

Thursday, June 23

12:15 p.m. Sky Room—Mapes

THURSDAY AFTERNOON

JUNE 23

Construction Division

2:00 p.m. Fable Room—Mapes

Presiding: W. C. Siler, Chairman, Committee on Construction of Nuclear Facilities

2:00 Nuclear Shielding Research

ARTHUR B. CHILTON, Capt., CEC, USN, U. S. Naval Civil Eng. Lab., Port Hueneme, Calif.

3:00 Nuclear Power Plant Construction at Shippingport

DONALD G. ISELIN, LCDR, CEC, USN, Exec. Officer and Asst. Dir., U. S. Naval Civil Eng. Lab., Port Hueneme, Calif.

3:45 Reactor Enclosure Foundation for Garigliano Nuclear Power Plant

RALPH B. GILE, J. SCAROLA and U. ORAZI, General Electric Co., Atomic Power Equipment Dept., San Jose, Calif.

Pipeline Division

2:00 p.m. Nevada Room—Mapes

2:00 Southern Pacific Pipeline Facilities at Sparks, Nev.

C. B. MILLER, Field Supt., Richmond-Fallon Pipeline, Southern Pacific Pipe Lines, Inc., Reno, Nev.

2:30 Virginia City Pipeline

3:00 "River Under the Desert"

A motion picture on Construction of Parallel Siphons on the Colorado River Aqueduct of the Metropolitan Water District of Southern California

Highway Division

2:00 p.m. Gourmet Room—Riverside

Presiding: Edward L. Pine, State Highway Engr., Dept. of Highways, Carson City, Nev.

2:00 Design Features of Salt Lake City Freeways

J. C. YOUNG, Chief Highway Engr., Porter, Urquhart, McCreary & O'Brien and Caldwell, Richards & Sorensen, Inc., Salt Lake City, Utah.

2:30 Location Studies for Interstate Highway 80 through Reno, Nev.

GEORGE S. RICHARDSON and CHARLES R. WAY, Partners, Richardson, Gordon & Assocs., Pittsburgh, Pa.

3:00 Problems of Community Acceptance of Location for Interstate Highway 80 through Reno, Nev.

JOHN BAWDEN, Asst. State Highway Engr., Dept. of Highways, Carson City, Nev.

3:30 California's West Side Freeway—285 Miles of New Location for Interstate Highway 5

J. C. WOMACK, State Highway Engr., and GEORGE LANGSNER, Engr. of Design, Calif. Div. of Highways, Sacramento.

4:00 Design of Interstate Highway 15 at Las Vegas, Nev.

ROBERT CONRADT, Staff Engr., DeLeuw, Cather & Co., San Francisco.

Irrigation and Drainage Division

2:00 p.m. Bonanza Room—Mapes

Conservation of Water

Sponsored by the Task Group on Methods of Conserving Water

Presiding: Arthur E. Bruington, Chairman, Task Group on Methods of Conserving Water

2:00 The Automatic Collapsible-Membrane Type of Rubber Dam and Its Uses

NORMAN M. IMBERTSON, Water Plant Operating Engr., Dept. of Water and Power, Los Angeles, Calif.

2:30 Effect on Native Ground-Water Quality of Spreading Colorado River Water

WESLEY HYLEN, Assoc. Civil Engr., Water Conservation Div., Los Angeles County Flood Control Dist.

3:00 Method for Estimating Consumptive Use of Water for Agriculture

WENDELL C. MUNSON, Hydraulic Engr., U.S.B.R., Washington, D. C.

3:30 Well-Point Device for Measuring Hydraulic Conductivity of Sand Strata

WILLIAM W. DONNAN, Drainage Engr., U.S.D.A., Agricultural Research Service, Pomona, Calif.

Power Division

2:00 p.m. Tahoe Room—Holiday

Presiding: J. George Thon, Chairman, Reno Program Committee, Power Div.

2:00 Power Prospects for the Sixties

F. L. WEAVER

Symposium on Use of Electronic Computers in Power Studies

2:45 Electronic Computer Use in Planning the Chungju and Mokelumne River Developments

P. E. POTTER

Electronic Computer Use in Scoping Lower Monumental Power Plant

3:30 Hallam Nuclear Power Facility

F. C. GRONEMEY and J. W. MERRYMAN

RODEO AND BARBECUE

Thursday, June 23 Horsemen's Park

4:00 to 5:00 p.m. Buses load on State Street near State Building
5:00 to 6:30 p.m. Rodeo
5:45 to 6:30 p.m. Refreshments for all ages.
6:30 to 8:30 p.m. Barbecue
8:30 to 9:00 p.m. Return by bus

Guest of Honor, Rex Bell, Lieutenant Governor, State of Nevada.

Horsemen's Park is located 5 miles southwest of Reno in the open country of the old West, close to the foothills of the Sierra Nevada Mountains and overlooking the cool green of Truckee Meadows. The Rodeo is a professional performance, with live horses and livelier vaqueros.

Tickets may be purchased until 5:00 p.m. Wednesday.

Price per plate, $7.00; children's plate, $4.00, including transportation.

FRIDAY MORNING

JUNE 24

Highway and Surveying and Mapping Divs. and Committee on Prof. Practice, Joint Session

9:00 a.m. Fable Room—Mapes

Presiding: L. A. Elsener, Vice Chairman, Dept. of Conditions of Practice

Symposium on Practice of Photogrammetric Surveying and Mapping

Moderator: William A. White, Executive Secretary, Calif. State Council of Civil Engineers and Land Surveyors, Sacramento

9:00 Obtaining Photogrammetric Mapping Under Contract

L. L. FUNK, Planning Engr., Calif. Div. of Highways, Sacramento.

9:30 Discussion

9:45 Negotiation of Photogrammetric Mapping Contracts

HENDERSON R. MCGEE, Asst. Chief, Eng. Div., Corps of Engineers, Sacramento, Calif.

10:15 Discussion

10:30 The Civil Engineer's Approach to Mapping Contracts

CLAIR A. HILL, Consulting Engr., Redding, Calif.

11:00 Discussion

11:15 Recent Transitional Developments in Mapping Practice

Irrigation and Drainage Division

9:00 a.m. Bonanza Room—Mapes

Presiding: Kenneth Q. Volk, Vice Chairman, Exec. Committee

9:00 **Reclamation of Sodic Soils with Sea Water**

RONALD C. REEVE and C. A. BOWER, Agricultural Engrs., U. S. Salinity Lab. and Western Soil & Water Management Branch of A.R.S., U.S.D.A., Riverside, Calif.

9:30 **Washoe Project—$50,000,000, multiple purpose**

ROBERT S. LEIGHTON, Water Resources Engr., Sierra Pacific Power Co., Reno, Nev.

10:00 **Research Studies in the State of Nevada**

HUGH A. SHAMBERGER, Director, Nevada State Dept. of Conservation and Natural Resources, Carson City, Nev.

10:30 **Performance of Model Recharge Wells Using Unfiltered or Filtered Water**

LEONARD SCHIFF, Project Supervisor, Ground Water Recharge Research Project, Soil and Water Conservation Research Project, A.R.S., U.S.D.A., Fresno, Calif.

PIPELINE DIVISION FIELD TRIPS

Friday, June 24

9:00 to 11:30 a.m. Southern Pacific Company's pipeline in its Sparks Division. Briefing session precedes field inspection of line and boosters.

2:00 to 5:00 p.m. Virginia City water-supply high-head aqueduct, long recognized as one of the engineering wonders of the West.

Buses will load on State Street near entrance to State Building, to leave at times scheduled above.

Tickets must be purchased by 5:00 p.m. Thursday.

POWER DIVISION AND USCOLD JOINT FIELD TRIP

Friday, June 24

8:30 a.m. to 5:00 p.m.

Inspection of dams, tunnels, penstocks and powerhouses under construction on the Upper American River Project of the Sacramento Municipal Utility District.

A 200-mile round trip via Carson City, Lake Tahoe and Echo Pass on U.S. 50 through the scenic wonderland of the Sierras to the rugged primitive area of this $85,000,000 project.

Buses will load on State Street near the State Building at 8:30 a.m. Tickets must be purchased before 5:00 p.m. on Thursday.

PACIFIC SOUTHWEST COUNCIL LUNCHEON

Friday, June 24

12:15 p.m. Olympic Room—Riverside

Presiding: FRANCIS G. CHRISTIAN, Chairman, Interim Committee, Pacific Southwest Council.

Program: To be arranged and announced by the Interim Committee

All members, guests and ladies are welcome. Tickets available until 9:00 a.m. on Friday, at Advance Registration Desk. Per plate, $3.00.

13TH ANNUAL PACIFIC SOUTHWEST CONFERENCE

Friday, June 24

2:00 p.m. Nevada Room—Mapes

Business Meeting, open to all members residing in District 11. Agenda will be posted at registration headquarters.

LADIES' ACTIVITIES

In addition to the GAQ Party Monday evening and the Rodeo and Barbecue Thursday evening, both planned for members and their ladies, and the regular luncheons and the Nevada Alumni Dinner, to which the ladies are welcome, the following are planned for their special interest and entertainment. Details in Ladies Souvenir Program.

Sunday, June 19

2:00 to 5:00 p.m. An informal Welcome Tea at the Holiday Hotel, for early birds. No charge.

Tuesday, June 21

Luncheon and Fashion Show featuring Early American and contemporary clothes, at Hidden Valley Country Club. $5.00 per person, including transportation.

Wednesday, June 22
Thursday, June 23

Two tours have been arranged for Wednesday and will be repeated on Thursday. Each is an "all-day" trip with luncheon included. Husbands are welcome.

Tour A runs to Virginia City with time for a walk through this historic ghost mining metropolis and returns via Carson City and Bowers Mansion. Price per person $6.00.

Tour B runs to Squaw Valley, with time for a scenic ride on a Winter Olympic chair lift (fare, $1.50), and return via Lake Tahoe and Mt. Rose. Price per person, $7.50.

Clothing should fit Reno's climate for June, a mean maximum temperature of 80.8 deg. F, mean minimum of 42.1 deg. F, low humidity, rain unlikely. A light sweater for daytime and a wrap for evening are recommended. Also recommended is informal dress of cottons and light summer fabrics, but dressier attire is optional for luncheon-fashion show and evening affairs, with street length the general rule on all clothing.

LADIES' HOSPITALITY ROOM

Room 602 in Hotel Mapes is hospitality center for the ladies, who are welcome Monday thru Friday from 9:30 a.m. to 5:00 p.m. Coffee each morning until 10:30.

CONVENTION COMMITTEES

General Co-Chairmen

Howard B. Blodgett
R. Robinson Rowe

General Committee

Howard B. Blodgett, John A. Bonell Jr., Francis G. Christian, Alan S. Hart, Clair A. Hill, Francis N. Hveem, Vernon M. Meiser, John G. Meyer, R. Robinson Rowe, Hugh A. Shamberger

Attendance Promotion

D. C. Clendenon, *Co-Chairman*
Henderson E. McGee, *Co-Chairman*

Howard E. Blower, Edgar T. Boardman, Donald F. Bolton, Grant K. Borg, Hugh E. Brinson, J. E. Christiansen, Harold Conkling, Grant Engstrom, Merle Fischer, C. Fred Hamlin, Alton F. Kay, L. E. Lippincott, Harry M. Moses, Ansel J. Myers, Embree Reynolds, M. J. Shelton, William H. Shewan, Frank Talbot, John A. Teerink, P. H. Van Etten, Howard C. Wood, Fred K. Woolley

Budget

Jack S. Barrish, *Co-Chairman*
E. W. McKenzie, *Co-Chairman*

James Flanagan, Richard G. Orcutt, W. J. Rabenstine

Entertainment

Carlo Panicari, *Co-Chairman*
Dudley F. Stevens, *Co-Chairman*

John E. Shevlin, T. Y. Sturtevant, James A. Thornton, A. M. Woodgate, Keith Yarborough, W. E. Lovering, Melvin E. Shore

Excursion

Eugene C. Sprout, *Co-Chairman*
George W. Smith, *Co-Chairman*

E. B. Longfield, A. J. Vandenberg

Hotel Committee

J. Webster Brown, *Co-Chairman*
J. A. Dobrowolski, *Co-Chairman*

L. G. Amundsen, H. L. Anderson, A. P. Bezonne, Jr., Eugene Calman, O. H. Degenkolb, R. F. Fingado, A. J. Gallardo, G. A. Hood, Jr., Bruce A. Krater, John B. Morgan, E. W. Stroppini

Interim Committee

Francis G. Christian, *Chairman*

Warren D. Curtis, Robert M. Cushing, William W. Moore, Robert A. Skinner, Russell L. Smith, Bert C. Wilkas

Nevada Alumni Dinner

Edward L. Pine, *Co-Chairman*
Charles R. Poppe, *Co-Chairman*

Pierre Aguerre, Richard Arden, George Assuras, Elmo De Ricco, G. D. Gilbert, John Gribben, Loren Henderson, Bruce Hicks, K. H. Johnson, Edward King, Dale Kulm, J. M. Morris, Jr., R. L. Whitaker

Officers Welcome

Ralph W. Hutchinson, *Chairman*

Printing

Allan A. Ramsey, *Co-Chairman*
Thomas C. Royce, *Co-Chairman*
Howard M. Byars

Program

Stewart Mitchell, *Co-Chairman*
Elwood T. Rose, *Co-Chairman*

Walter A. Brown, Harry Dettmer, R. H. Dewante, George Gleason, Milton Harris, William Hegy, Daniel Howe, Carl Jennings, George Langsner, Dee McKenzie, Arthur W. Root, R. Robinson Rowe, Dwight Rutledge, Walter G. Schulz, John A. Teerink

Public Relations

Scott H. Lathrop, *Co-Chairman*
Milton L. Sharp, *Co-Chairman*

J. J. Doody, D. F. Henneman, H. P. O'Donnell, G. B. Sherman

Reception

Walter G. Schulz, *Chairman*

Martin H. Blote, Drury Butler, Conrad A. Ecklund, Edwin A. Fairbairn, Ridgway M. Gillis, George E. Goodall, Gerald H. Jones, Fred W. Panhorst, Harlowe M. Stafford, Thomas E. Stanton, Edwin F. Sullivan, W. Fitzhugh Turner, Thomas B. Waddell, Everett L. Walsh

Registration

Thomas K. Meredith, *Co-Chairman*
Thomas P. Wootton, *Co-Chairman*

Richard M. Bradley, Charles Breese, Clarence Dettloff, Wayne T. Donnels, Gerard A. Hayes, Jacob Holderman, Wayne Kammerer, Al Moellenbeck, Robert T. Ramsey, James P. Staehs

Sacramento Headquarters Committee

Robert M. Carmany, *Chairman*

Harold Russell, Harvey A. Towne, P. R. Watson

Section Convention Fund

I. M. Ingerson, *Chairman*

Conrad A. Ecklund, R. W. Hutchinson

Society Affairs

Walter G. Schulz, *Chairman*

Francis N. Hveem, Henderson E. McGee, F. W. Panhorst, R. Robinson Rowe

Special Activities

Gordon L. Long, *Chairman*

Carroll M. Hamon, Associate Member Forum

Student Activities

Charles Breese, *Co-Chairman*
George B. Sherman, *Co-Chairman*

Treasurer

Glenn R. Peterson

LADIES COMMITTEES

Convention Hostesses

Mrs. H. B. Blodgett
Mrs. R. Robinson Rowe

Executive Committee

Mrs. John A. Bonell, *Co-Chairman*
Mrs. Francis N. Hveem, *Co-Chairman*

Mrs. T. Webster Brown, Mrs. Francis G. Christian, Mrs. Clair A. Hill, Mrs. Vernon M. Meiser, Mrs. T. K. Meredith, Mrs. Walter G. Schulz

Finance

Mrs. I. M. Ingerson, *Co-Chairman*
Mrs. Bruce A. Krater, *Co-Chairman*

Mrs. James A. Thornton

Hospitality

Mrs. John L. Beaton, *Co-Chairman*
Mrs. Wayne T. Donnells, *Co-Chairman*

Mrs. E. B. Longfield

Information-Registration

Mrs. J. Webster Brown, *Co-Chairman*
Mrs. W. Calvin Kiedaisch, *Co-Chairman*

Mrs. E. E. Sorenson, Mrs. William A. White

Luncheon

Mrs. Pierre Aguer, *Co-Chairman*
Mrs. Wentworth Lovering, *Co-Chairman*

Printing

Mrs. R. W. Hutchinson, *Co-Chairman*
Mrs. W. J. Rabenstine, *Co-Chairman*

Mrs. Richard G. Orcutt

Publicity

Mrs. J. Carl Jennings, *Co-Chairman*
Mrs. Carlo Panicari, *Co-Chairman*

Transportation

Mrs. Howard M. Byars, *Co-Chairman*
Mrs. George B. Gleason, *Co-Chairman*

Mrs. Joe Dobrowolski, Mrs. Charles R. Breese

ENGINEERS' NOTEBOOK

Welded angle connections—design shortcut

ALLAN W. GILMAN, M. ASCE, Associate

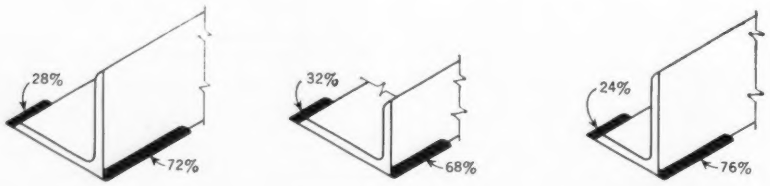
Patchen, Mingledorff and Williams, Augusta, Ga.

In the design of welded connections, an attempt should be made to avoid the development of stresses due to eccentricity of the connection. This can be done by arranging the connection so that its center of gravity coincides with that of the member in the connected plane.

Since the relative position of the center of gravity of all angles of the same type—that is, equal or unequal legs—has been found to be similar, the distribution of weld to each side of the connecting leg is also similar.

In Fig. 1, mean values are given for distributing the weld to avoid eccentricity for the three connection conditions. The deviations from exact values are well within the practical limits of design.

FIG. 1. Welds for the three types of angle connections are shown, with the percentage of total weld required for each connection.



EQUAL LEGS, ONE LEG ATTACHED
For all angles from L8 x 8 x 1⅛ to L2 x 2 x ⅛ inclusive

UNEQUAL LEGS, LONG LEG ATTACHED
For all angles from L8 x 6 x 1 to L2½ x 2 x 3/16 inclusive

UNEQUAL LEGS, SHORT LEG ATTACHED
For all angles from L8 x 6 x 1 to L2½ x 2 x 3/16 inclusive

AMERICAN SOCIETY OF CIVIL ENGINEERS

Research Conference on Shear Strength of Cohesive Soils

Sponsored by the Soil Mechanics and Foundations Division, ASCE

Location: University of Colorado, Boulder, Colo., June 13-17, 1960
Headquarters and Registration in Hallett Residence Hall

Hosts: Colorado Section, ASCE, and University of Colorado
Technical Sessions in Auditorium of New Chemistry Building

REGISTRATION

For Delegates and Families

Sunday, June 12, 9:00 a.m. to 8:00 p.m.

Monday, June 13, 8:00 a.m. to 5:00 p.m.
Tuesday, June 14, 9:00 a.m. to 4:00 p.m.
Conference registration fee, $15.00 (ladies and children no charge). This fee includes copies of preprinted papers and a bound copy of the final proceedings of the conference.

University registration fee, $1.50 (ladies and children no charge).

PANEL BREAKFASTS

Persian Room, University Memorial Center

7:30 a.m., Tuesday, Wednesday, and Thursday

All moderators, associate moderators, and panelists for the day.

MONDAY AFTERNOON JUNE 13

Session 1

2:00 to 4:30 p.m.

Chairmen: S. Mark Davidson, President, Colorado Section, ASCE; Chief Engineer, Thompson Pipe & Steel Co., Denver; Willard J. Turnbull, Chairman, Task Committee on Shear Strength of Soils, ASCE, and Chief, Soils Division, USAE Waterways Experiment Station
Assistants: M. J. Hvorslev and J. W. Hilf

Opening Address: Eugene H. Wilson, Vice President, University of Colorado

Lecture on Failure Hypotheses: Nathan M. Newmark, Head, Department of Civil Engineering, University of Illinois

Discussion: Ralph B. Peck, Professor of foundation Engineering, University of Illinois

GET-ACQUAINTED HOUR

Monday Evening, June 13

6:00 to 7:30 p.m. Get-acquainted hour for registrants and wives. Banquet Hall, 5th floor, Harvest House of Boulder.

ACCOMMODATIONS IN BOULDER

The University of Colorado is placing a residence hall, with comfortable rooms and dining-room facilities, at the disposal of the conference. Meals and refreshments can also be obtained at the University Memorial Center. The Harvest House of Boulder, a recently completed hotel with 150 rooms, is located ¾ mile from the conference auditorium. There are many new and comfortable motels in or near Boulder. Preregistration and reservation requests may be addressed to Dr. J. W. Hilf, Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colo.

TUESDAY MORNING JUNE 14

Session 2

9:00 to 11:40 a.m.

Topic: Testing Equipment, Techniques, and Errors.

Moderator's summary, panel discussion, and general discussion

Moderator: Arthur Casagrande, Professor of Soil Mechanics and Foundation Engineering, Harvard University

Associate Moderator: Stanley D. Wilson, Partner, Shannon and Wilson, Seattle

Panel:

Alan W. Bishop, Reader in Soil Mechanics, Imperial College of Science and Technology, University of London.

Wesley G. Holtz, Chief, Earth Laboratory, Bureau of Reclamation.

Woodland G. Shockley, Assistant Chief, Soils Division, USAE Waterways Experiment Station, Vicksburg, Miss.

A. A. Warlam, Consulting Engineer, Hastings-on-Hudson, N. Y.

Robert V. Whitman, Associate Professor of Soil Engineering, Massachusetts Institute of Technology, Cambridge.

FAMILY WESTERN BARBECUE

Tuesday Evening, June 14

6:30 p.m.

Family Western Barbecue at Memorial Terrace, University of Colorado. Informal barbecue for delegates, wives, and families. Entertainment and square dancing will follow.

Cost: Adults $2.75, children under 12 years $1.75.

TUESDAY AFTERNOON JUNE 14

Session 3

2:00 to 4:40 p.m.

Topic: Shear Strength of Saturated, Remolded Clays

Moderator's summary, panel discussion, and general discussion

Moderator: Stanley J. Johnson, Associate, Moran, Proctor, Mueser & Rutledge, New York

Associate Moderator: Robert V. Whitman, Associate Professor of Soil Engineering, Massachusetts Institute of Technology

Panel:

Alan W. Bishop, Reader in Soil Mechanics, Imperial College of Science and Technology, University of London.

Laurits Bjerrum, Director, Norwegian Geotechnical Institute, Oslo.

M. Juul Hvorslev, Consultant, USAE Waterways Experiment Station, Vicksburg, Miss.

T. William Lambe, Prof. and Head, Soil Engineering, Mass. Inst. of Tech., Cambridge.

Jorj O. Osterberg, Professor of Civil Engineering, Northwestern University, Evanston, Ill.

WEDNESDAY MORNING

JUNE 15

Session 4

9:00 to 11:40 a.m.

Topic: Shear Strength of Undisturbed Cohesive Soils

Moderator's summary, panel discussion, and general discussion.

Moderator: Ralph B. Peck, Professor of Foundation Engineering, University of Illinois, Urbana.

Associate Moderator: John Lowe, III, Associate Partner, Tippetts-Abbett-McCarthy-Stratton, New York, N. Y.

Panel:

Laurits Bjerrum, Director, Norwegian Geotechnical Institute, Oslo.

Harold J. Gibbs, Supervisory Civil Engineer, Soil Mechanics, Earth Laboratory, Bureau of Reclamation, Denver, Colo.

James P. Gould, Associate, Moran, Proctor, Mueser & Rutledge, New York, N. Y.

Ronald C. Hirschfeld, Instructor in Soil Mechanics, Harvard University, Cambridge, Mass.

Raul J. Marsal, Research Engr., Instituto de Ingeniería, Universidad Nacional de México.

Stanley D. Wilson, Partner, Shannon and Wilson, Seattle, Wash.

THURSDAY MORNING

JUNE 16

Session 5

9:00 to 11:40 a.m.

Topic: Shear Strength of Compacted Cohesive Soils

Moderator's summary, panel discussion, and general discussion

Moderator: H. Bolton Seed, Associate Professor of Civil Engineering, University of California, Berkeley.

Associate Moderator: Ronald C. Hirschfeld, Instructor in Soil Mechanics, Harvard University, Cambridge, Mass.

WEDNESDAY TOURS

Wednesday Afternoon, June 15

For Participants and Families

Tour No. 1, Colorado-Big Thompson Project

1:30 to 7:30 p.m.

Study tour of Bureau of Reclamation earth dams, power plants, pumping plants, canals, and siphons in the foothills of the Rocky Mountains; dinner at Colorado State University, Fort Collins.

Cost per person, including bus transportation and dinner, $5.50

Tour No. 2, U. S. Air Force Academy

1:30 to 9:30 p.m.

Guided tour of the new Academy near Colorado Springs, including buffet dinner at the Officers' Open Mess

Cost per person, including bus transportation and dinner, $6.00

Panel:

Reginald A. Barron, Engineer, Civil Works, Office of the Chief of Engineers, Department of the Army, Washington, D. C.

Alan W. Bishop, Reader in Soil Mechanics, Imperial College of Science and Technology, University of London

Jack W. Hilf, Supervisory Civil Engineer, Soil Mechanics, Earth Dams, Bureau of Reclamation, Denver, Colo.

T. William Lambe, Professor and Head, Soil Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

Jorj O. Osterberg, Professor of Civil Engineering, Northwestern University, Evanston, Ill.

THURSDAY AFTERNOON

JUNE 16

Session 6

2:00 to 4:40 p.m.

Topic: Some Problems Associated with Practical Applications of Shear Strength Data

Moderator's summary, panel discussion, and general discussion

Moderator: Philip C. Rutledge, Partner, Moran, Proctor, Mueser & Rutledge, New York, N. Y.

Associate Moderator: Fred C. Walker, Head, Earth Dams Section, Bureau of Reclamation, Denver, Colo.

Panel:

George E. Bertram, Chief of Soils Branch, Civil Works, Office of the Chief of Engineers, Department of the Army, Washington, D. C.

Laurits Bjerrum, Director, Norwegian Geotechnical Institute, Oslo.

Arthur Casagrande, Professor of Soil Mechanics and Foundation Engineering, Harvard University, Cambridge, Mass.

Don U. Deere, Professor of Civil Engineering and of Geology, University of Illinois, Urbana.

John Lowe, III, Associate Partner, Tippetts-Abbett-McCarthy-Stratton, New York, N. Y.

Gregory P. Tschebotarioff, Professor of Civil Engineering, Princeton, N. J.

CONFERENCE BANQUET

Thursday Evening, June 16

Jointly with Colorado Section, ASCE, at Harvest House of Boulder

6:00 to 7:00 p.m. Informal cocktail hour

7:00 to 9:00 p.m. Banquet, 5th floor

Speaker: Ellis L. Armstrong, Commissioner, Bureau of Public Roads, Washington, D. C.

Subject: Cohesion—Soils and People

Toastmaster: Arthur Casagrande, Professor of Soil Mechanics and Foundation Engineering, Harvard University, Cambridge, Mass.

9:30 p.m. to 1:00 a.m. Dancing on terrace.

Cost of dinner and dancing: Per person $5.50

FRIDAY MORNING

JUNE 17

Session 7

9:00 to 11:40 a.m.

Presiding: Willard J. Turnbull, Chairman, Task Committee on Shear Strength of Soils; Chief, Soils Division, USAE Waterways Exp. Station, Vicksburg, Miss.

Assistants: M. J. Hvorslev and J. W. Hilf

Reports by moderators on panel sessions

General discussion

Closing of conference

OPEN HOUSE

At Bureau of Reclamation Laboratories

Friday Afternoon, June 17

1:15 to 5:00 p.m. Open House at Bureau of Reclamation Laboratories near Denver.

Guided tours of Soils, Concrete, Hydraulics, and Chemical Laboratories.

Cost per person for round-trip bus transportation $1.25.

LADIES' ACTIVITIES

All persons accompanying delegates are invited to participate.

Monday Afternoon, June 13

3:30 p.m. Get-acquainted reception, University Memorial Center. No charge.

Tuesday, June 14

9:00 a.m. to 3:30 p.m. Tour of historic Central City in the Rocky Mountains. Lunch in Central City. Cost per person, including bus fare and lunch at Teller House, $4.00.

Thursday Morning, June 16

11:00 a.m. Tour of University Campus.

12:30 p.m. Wives' luncheon and bridge, if desired, University Faculty Club. Cost per person $1.50.

All conference social activities are open to families accompanying registrants.

EQUIPMENT EXHIBIT

Exhibits of laboratory and field equipment related to the conference will be available for viewing daily from 8:00 a.m. to 5:30 p.m. in Engineering I Building of the University.

CONFERENCE COMMITTEES

ASCE Task Committee on Shear Strength of Soils

Willard J. Turnbull, *Chairman*
M. Juul Hvorslev, *Vice Chairman*
Jack W. Hilf, *Secretary*

Reginald A. Barron, Arthur Casagrande, Ralph B. Peck, H. Bolton Seed

Local Committee on Arrangements

Wesley G. Holtz, *Chairman*

Milton E. Bender, Jr., Hugh W. Hempel, James G. Johnstone, Mrs. James G. Johnstone, Warren Raeder, Roland C. Rautenstraus, Edward Sampson, Jr., Jack W. Hilf

THE READERS WRITE

Pipe-flow formulas compared by nomograph

To THE EDITOR: I note in the March issue (vol. p. 192), a discussion by E. M. Laursen on my article, "Pipe Flow Formulas Compared by Nomograph" (November 1959 issue, vol. p. 796).

I wish to state that my reply to M. D. Lester's discussion (Feb. 1960 issue, vol. p. 117) can also serve in general to answer Mr. Laursen. As I mentioned before, the nomographic presentation in my article cannot be regarded as an approach to the general description of pipe-flow analysis, and the discussion should not be carried beyond the intended scope of my article.

Mr. Laursen objects to my description that ". . . the coefficient C of the Hazen-Williams formula and the coefficient C of the Chezy formula are numerically equal." Actually a similar description can be found in the latest *Handbook of Hydraulics*, by H. W. King (pp. 6-11, 1954 edition), which reads exactly as follows:

"The formula, . . . is
$$V = C_1\, r^{0.63}\, S^{0.54}\, 0.001^{-0.04}$$

The expression $0.001^{-0.04}$, which equals 1.318, was introduced to equalize the value of C_1 with the value of C in the Chezy formula."

I hope this passage will help to clarify my original statement.

FRANCIS S. Y. LEE, F. ASCE
Ebasco Services, Inc.

New York, N. Y.

Concrete mixes vary with aggregates used

To THE EDITOR: The article by Guy F. Tabor, Jr., A.M. ASCE, in the March Engineers' Notebook, "Concrete Mixes Designed by Nomograph," is of considerable interest. Mr. Tabor is to be commended for his ingenuity and the time and effort spent in preparing a chart such as this. However, implications can be drawn from this article that would be misleading to engineers not fully experienced in the problem of concrete mix design. The nomograph would definitely be useful if referenced to specific aggregate systems, but would be erroneous as to basic water content for different types of coarse aggregate.

The accompanying Table I shows the actual water content in gallons per yard for a 4-in. slump for three different types of coarse aggregate. Note the difference between the water requirements given in the nomograph and those we have found to be correct by laboratory tests.

Engineers who are continually in contact with laboratory design procedures for concrete mixes are hesitant to oversimplify these procedures, knowing from experience the fallacy of this approach.

I therefore feel that the readers should be cautioned that concrete mix tables can be given only for specific aggregates or specific aggregate types, and the preparation of concrete mix designs is of necessity accomplished in the laboratory under qualified engineering supervision and experience.

TABLE I. Water demand by nomograph and by laboratory tests

				Actual Water Demand, gal per yd		
Max. Size, Coarse Aggregate	C33 Coarse Aggregate Size Designation	Air Entrainment	Water Demand from Nomograph	Minnesota Glacial gravel, 20% crushed	Crushed limestone	Montana gravel (rounded)
1½ in.	No. 467	No	36.5	34	37	32
1½ in.	No. 467	Yes	32.5	32	35	30
¾ in.	No. 67	No	Not Determinate	36	39	34
¾ in.	No. 67	Yes	36.5	34	37	32

NORMAN E. HENNING, M. ASCE
Twin City Testing and Engineering Laboratory, Inc.

St. Paul, Minn.

ASCE Was Manager of 1960 Nuclear Congress

New York City—site of the first demonstration in the United States of energy release from uranium fission by scientists at Columbia University (in 1939)—was recently the scene of the Sixth Nuclear Congress. Devoted to the peaceful uses of nuclear energy, the three-day conference, held in New York's Coliseum in early April, attracted some 3,500 engineers and scientists from all over the world.

Nuclear Power and the Civil Engineer

Civil engineers are playing and will continue to play an important role in nuclear power developments throughout the world. This was the conclusion of R. W. Kupp and J. C. Tourek, of the Vitro Engineering Co., in reporting on civil engineering aspects of nuclear power plants.

They showed that the civil engineer is concerned, first, with the site selection. In addition to consideration given to the usual factors, greater emphasis must be placed on such things as land cost and geology for the large-scale site development. Also receiving the civil engineer's attention during site selection is the nuclear hazard condition, which relates to population density, hydrology and seismology.

Second, the foundation requirements for massive concrete structures, the design and support of large containment vessels, and the design of large radiation shields are of immediate concern to the civil engineer. The authors reviewed the Consolidated Edison reactor being constructed at Indian Point, N. Y. Concrete walls, $5\frac{1}{2}$ ft thick and 170 ft in diameter, and a heavy concrete domed roof 2 ft 9 in. thick (weighing 400 psf), free spanning the wall diameter, presented unique civil engineering problems which were never considered prior to the development of nuclear shielding requirements.

The scheme evolved consisted of a series of inverted T-shaped precast concrete ribs, tied into a small center compression ring and attached to the top section of the concrete wall which is $7\frac{1}{2}$ ft thick and prestressed for a distance of 15 ft down the wall. Precast concrete planks are set in between the ribs resting on the T-bar edges.

The Army Nuclear Power Program

Self sufficiency—the principal military advantage of a nuclear power plant—enables the logistical support of the plant to be based on feasibility and convenience rather than an essentially continuous basis. One nuclear core for the power plant at Fort Belvoir is equivalent to 60,000 barrels of oil, which is about the capacity of a medium tanker. Ratio by weight, as far as fuel logistics are concerned, is 1 to 25,000.

In describing the army nuclear power program, Col. Donald G. Williams continued to state that the principal disadvantage of a nuclear power plant is its high initial cost. The capital cost of the army's nuclear plant being built in Alaska is about three times the cost of a corresponding diesel plant. One of the major objectives of the army's current development effort is to reduce the costs of remote plants, primarily by reducing the amount of high cost on-site construction.

Colonel Williams stated that for military use, and considering only the operating costs to the using service, it appears that nuclear power becomes competitive with diesel power when oil costs at the site approach 15 to 20 cents a gallon for a 20,000-kw plant or 45 cents per gallon for a 2,000-kw plant.

It is the aim of the services, Colonel Williams concluded, to develop plants whose economic and technical feasibility is of such promise that they will be important considerations in determining military budgets, even though first costs may be higher than for conventional plants.

Regulatory Activities

Regulations protecting public health were discussed in a session on environment. It was pointed out by Dr. Francis J. Weber, of the U. S. Public Health Service, that under our constitution, the ultimate responsibility in our country for most aspects of health protection—including radiological health—is in the states. The major roles of the Public Health Service are to conduct investigations and to assist the states. The Service also cooperates in radiological health matters with other federal agencies, universities, and international organizations and committees laboring in this vitally important and increasingly complex field.

Hanson Blatz, director of the New York City Office of Radiation Control, presented the local problems in regulation of radiation. He stated that the most important aspect of regulation is the location and description of sources of radiation hazards. This is taken care of in New York by the mandatory registration of all radiation sources. Inquiries and complaints are investigated, and proper action is taken. The city also attempts to keep informed of any plans for atomic energy activities in the area, such as nuclear power shipping. It will then be prepared to interpret the Health Code as such special cases arise or, if necessary, recommend amendments to the Health Code.

Nuclear Congress poster attracts attention of Congress Chairman Clarke Williams (center); William H. Wisely, Executive Secretary of ASCE; and Don Reynolds, Assistant to Secretary of ASCE and Congress manager.

Atomic Exposition

The Sixth International Atomic Exposition was held in conjunction with

the Nuclear Congress. Canada, France, and Switzerland were represented in the Exposition as well as nearly 150 companies and agencies from the United States. The display, representing a $15 billion industry, covered the fields of designers, builders, manufacturers and services.

Students View The Future

Thirteen hundred high school students and their faculty advisers were guests of the Congress at a special Student Day program. Featured in an orientation program for the students was a discussion by Dr. A. B. Kinzel, vice president of the Union Carbide Co., and president of EJC, of careers available in the nuclear industry. He stated that new developments will create many new positions, thus increasing the present shortage of trained personnel in the nuclear field. Dr. John R. Dunning, cited as the first man to split the atom in the United States, in discussing the educational requirements for careers in nuclear science, stressed the needs for mathematical and scientific prerequisites for the prospective atom scientist. A tour of the Atomic Exposition concluded the Student Day program.

Papers Available

A total of twenty-eight engineering and scientific organizations supported the 1960 Nuclear Congress, which is sponsored by Engineers Joint Council. This year the Congress was managed by ASCE. Papers from the meeting have been printed separately in pocket-size booklets and are available on request, at 50 cents a copy. Inquiries should be addressed to EJC, 29 West 39th St., New York 18, N. Y.

L. K. Wheelock Is New EJC Secretary

Leroy K. Wheelock has been elected secretary of Engineers Joint Council, replacing E. Paul Lange, who resigned on March 1 to become executive secretary of the American Institute of Industrial Engineers. Mr. Wheelock has been assistant secretary of EJC since 1956 and, more recently, executive secretary of the Engineering Manpower Commission. A mining engineer, graduate of Iowa State College and holder of a master's degree from the Missouri School of Mines, in 1952, he practiced engineering until 1956.

He is a member of the AIME, ASEE, Committee on Specialized Personnel, Office of Civil and Defense Mobilization, and the National Defense Executive Reserve.

ASCE-AGC Suggested Form of Contract

A revised edition of the "Suggested Form of Contract, ASCE Form JCC-1," is just off the press. This document is intended for use in connection with agreements between clients, private and public, and contractors. It serves as a guide in the preparation of contract documents for all types of engineering construction except building.

Contract forms covering three alternative bases of payment to the contractor are featured. These are (1) Lump Sum, (2) Unit Price, and (3) Cost-Plus. The section, "General Conditions of Contract," suitable for most uses, is condensed into eight pages of readily understood plain talk.

The Standard Form of Contract was prepared by the ASCE-AGC Joint Cooperative Committee, and is being distributed by ASCE and the Associated General Contractors of America, Inc. Copies are available at cost—25 cents each. Address your request to ASCE Headquarters. In ordering please refer to ASCE Form JCC-1.

E. L. Chandler Retires as Assistant Secretary

E. Lawrence ("Tink") Chandler retired March 31 as Assistant Secretary of the Society after serving in the position since 1948. He will continue in the post of Treasurer of ASCE, to which he was named in 1959. He is also treasurer of three other organizations—Engineers Joint Council (since 1948); the Pan American Federation of Engineering Societies (UPADI) Fund; and the U.S. Committee of the World Power Conference.

Prior to his election as Assistant Secretary in 1948, Mr. Chandler was representative in charge of the Society's Washington office. A specialist in the construction of dams, flood control works, and hydroelectric projects, he had been with the Providence (R.I.) Board of Water Supply; the Miami Conservancy District at Dayton, Ohio; and the Tennessee Valley Authority. At the time of joining the ASCE staff he was project engineer on the construction of the Dravo Shipyard at Wilmington, Del.

As Assistant Secretary, Mr. Chandler coordinated the Society's multiple activities in the Department of Conditions of Practice, including education, registration, salaries, and employment conditions. He is the author of numerous CIVIL ENGINEERING articles on professional problems arising in the course of his work. As convocation manager of the ASCE Centennial of Engineering, Mr. Chandler put in years of preliminary work that did much to assure the success of the Chicago Convocation of 1952, the climax of the centennial year celebration.

At its New Orleans meeting the Board of Direction cited Mr. Chandler for his "stability of judgment, friendliness and wisdom" and expressed its "deep debt of gratitude" to him. The Board has also selected him as first winner of the newly established ASCE Professional Recognition Award (April issue, page 88), to be given annually to an ASCE member "who is judged to have contributed substantially to the status of the engineering profession." He will receive the award, consisting of a wall plaque and formal certificate, at the Reno Convention in June.

Mr. Chandler receives staff gift of wrist watch. Presentation is made by Mr. Wisely.

Electronic Computer Applications

The following descriptions of applications of electronic computers to the solution of civil engineering problems have been prepared from information assembled by the Task Committee on Program Directory and Library of the Structural Division's Committee on Electronic Computation. The present listing continues a series appearing in alternate issues (see the March issue, page 80).

To assist the Task Committee in its aim of assembling a comprehensive directory of computer applications in the structural engineering field, readers are invited to send information to: John J. Kozak, ASCE Task Committee, P. O. Box 1499, Sacramento 7, Calif.

Program St. 19: Rigid Frame Pier Analysis

Equipment: Bendix G-15.

Programmed by: Michigan State Highway Department.

Purpose: To compute the section properties, stresses and cost per square foot of a given plate girder for a given live load moment.

Limitations: Intended for preliminary design only.

Input-Output: Input is a complete description of the girder to be analyzed, the girder spacing, live load moment, and the number of girders per span. Output includes the section properties, stresses, moments, cost per foot, and a description of the girder.

Machine Details: Programmed in Intercom 1,000's using 500 commands. Running time is about 2 minutes plus type out.

Availability: A complete write-up is not available at this time.

Program St. 20: Composite Beam Analysis

Equipment: Bendix G-15.

Programmed by: Michigan State Highway Department.

Purpose: To compute the properties of the composite section, moments, shears, stresses, etc., for a given steel beam.

Limitations: Properties of the basic steel beam must be given. No selection of section is done.

Input-Output: Input includes complete description of the steel and concrete section, live load to be applied, girder spacing, and span. Output reports the section properties of both composite and basic section, stresses, reactions, deflections, cover plate lengths, shear connector pitch, and frequency of vibration.

Machine Details: Programmed in Intercom 101 using 800 locations. Running time approximately 5 minutes.

Availability: Complete write-up not available at this time.

Program St. 21: Wind Analysis of Tall Buildings

Equipment: Bendix G-15.

Programmed by: Scientific Computers, Inc., Minneapolis, Minn.

Purpose: To compute moments and shear at each end of beams, and moments at each end of columns of a multi-story rigid-frame building due to horizontal forces caused by either wind or earthquake effects.

Method: The Modified Maney-Goldberg slope-deflection method was adopted for computer application. Program first computes and stores initial slopes and sideways, then by successive corrections on these values it approaches the final solution. Number of successive corrections may be increased if more accuracy is desired.

Limitations: Maximum number of stories 20; maximum number of bays 3. The columns at the base of the frame may be of any degree of fixity desired, from hinged to fixed.

Input-Output: Relative or actual moments of inertia of beams and columns, floor heights, forces at each floor level and span lengths are required as input. The output consists of moments and shears at each end of beams, moments at each end of columns.

Machine Details: Programmed in INTERCOM 1,000's using about 1,200 commands and 500 storage locations.

Availability: This program will be available through Bendix Users' Exchange Organization, c/o Mr. Winfield O. Salter, Parsons, Brinckerhoff, Quade & Douglas, 165 Broadway, New York 6, N. Y.

Program St. 22: Truss Design (C103008)

Equipment: IBM 650.

Programmed by: Computing and Data Processing Center, University of Houston, Houston, Tex.

Purpose: To design or check the members of 3-dimensional trusses such as power transmission towers, oilwell derricks, etc.

Method: Forces due to the various loadings are combined to produce maximum stress in each member. This stress, along with L/r criteria, is used to select an angle size for each member.

Limitations: Leg members designed for A-7 and A-242 steel. Bracing members designed for A-7 steel only.

Input-Output: The input consists of the sorted output from the University of Houston Truss Analysis program (C103001A) plus a description of the truss configuration. The output includes the following for each member: Actual and allowable stresses, length, controlling load combination, size of angle selected, required and selected net area and radii of gyration, number of bolt holes cut and weight of member.

Machine Details: Programmed in S.O.A.P., using approximately 1,950 locations. Average operating time 5 sec per member.

Availability: This program is available at no charge under an agreement with the University. Write: Computing and Data Processing Center, University of Houston, Houston, Tex.

Program St. 23: Connector and Redundancy Programs for Indeterminate Truss Analysis (C103002-C103003-9980-C103004)

Equipment: IBM 650.

Programmed by: Computing and Data Processing Center, University of Houston, Houston, Tex.

Purpose: To extend the analysis of determinate trusses by program C103001(St. 1) to compute the true axial forces on members of indeterminate trusses.

Method: Castigliano's Theorem of Least Work.

Limitations: Same as C103001, Determinate Truss Analysis, plus a maximum of 24 redundants.

Input-Output: The input includes the length and area of each member plus the sorted output from the Determinate Truss program. The output includes the axial forces on each member.

Machine Details: Program 9980 programmed in machine language, all others in S.O.A.P., using approximately 1,700 locations in each program. Running time example: 30 min for 90 members with 10 redundants.

Availability: Available through IBM Program Library, 590 Madison Avenue, New York, N. Y.

Program St. 24: Analysis of stress due to bending and direct thrust on reinforced concrete

Equipment: Burroughs E-102.

Programmed by: Corps of Engineers, Kansas City, Mo.

Purpose: To compute the stresses and location of the neutral axis on a concrete member.

Method: Trial and error determination of the neutral axis.

Limitations: e less than 1,000

Input-Output: The input is the size of section, area of reinforcement, and loads. The output includes the maximum tensile and compressive stress and the location of the neutral axis.

Machine Details: Fifty-eight drum locations utilized. Average running time 3 min; 14 pinboards used.

Availability: This abstract is included through the courtesy of the Corps of Engineers with the understanding that the abstract itself is public property and not subject to copyright. This abstract is accordingly exempted from the general copyright notice applicable to this publication. Address inquiries: Department of the Army, Office of the Chief of Engineers, Engineer Data Processing Center, Washington 25, D.C.

Program St. 25: Curve Values for Combined Moment and Axial Tension

Equipment: Burroughs E-102.

Programmed by: Corps of Engineers, Kansas City, Mo.

Purpose: To solve the equation $-x^3 + (3+3a)x^2 + (6apn)x = 6apn$ for x to aid in the computation of concrete and steel stresses.

Method: Trial and error solution to the equation given under "Purpose."

Limitations: Precision is to three significant figures.

Input-Output: Input includes steel ratio, force and length. Output is the value of x.

Machine Details: Program uses 20 memory locations. Running time 40 sec. Seven pinboards used.

Availability: Same as in Program St. 24.

Program St. 26: Balanced Spot Footing Design (Parts 1 & 2)

Equipment: IBM 650.

Programmed by: Corps of Engineers, Albuquerque District, Albuquerque, N. Mex.

Purpose: *Part 1:* To determine base size of square spot footings in design of buildings. *Part 2:* To design steel reinforcement and determine minimum effective depth.

Method: *Part 1:* Methods used are those recommended by L. C. Urquhart in the third edition of "Civil Engineering Handbook," Section 8, Page 736. *Part 2:* Computations in accordance with Chapter 12 of ACI Building Code for Reinforced Concrete (ACI 318-56).

Limitations: Maximum of 200 load variations. Square footings only.

Input-Output: *Part 1:* The input includes the loadings and the allowable design bearing pressure. *Part 2:* The input is output of Part 1. The output includes the plan size of the footing, required reinforcement, and minimum depth.

Machine Details: *Part 1:* Occupies 222 storage locations for instructions and 1,399 locations for data storage. Running time 2 to 3 min. Not relocatable. *Part 2:* Occupies 115 storage locations. Running time 2 to 3 min. Programmed in S.O.A.P. Relocatable.

Availability: Same as in Program St. 24.

Program St. 27: Concrete General Flexure Analysis

Equipment: IBM 650.

Programmed by: U.S. Army Engineer Division, North Pacific 210 Custom House, Portland, Ore.

Purpose: To compute the neutral axis of a reinforced concrete section subjected to any combination of axial load, and bending stresses in concrete and steel are computed.

Method: Computed in accordance with Appendix "D," AASHO Specs for Highway Bridges (1957).

Limitations: Maximum of 75 concrete point coordinates; maximum of 75 units of steel.

Input-Output: The input includes the coordinates of each corner of the concrete section and each bar or each end of each row of reinforcing steel and the axial load and bending moments. The output includes the coefficients to the basic equation and the stress in the steel and concrete at each given coordinate.

Machine Details: Programmed in S.O.A.P., using the S.I.R. floating point arithmetic. Occupies the entire drum. Running time given is 4.25 sec per iteration for each set of concrete coordinates given plus 1.67 sec per iteration for each bar. Three to eight iterations required.

Availability: Same as in Program St. 24.

Program St. 28: Moment Distribution (C10302)

Equipment: IBM 650

Programmed by: Computing and Data Processing Center University of Houston, Houston, Tex.

Purpose: To compute balanced bending moments in rigid frame members.

Method: Hardy Cross Moment Distribution.

Limitations: Maximum number of members 99; maximum number of members meeting at a joint 8, Constant I members only (carryover 0.5).

Input-Output: The input includes the following: (1) Distribution factors at each end of each members; (2) joints at which each member ends; (3) fixed end moments, and (4) tolerances stated as minimum carry-over moment and maximum number of iterations. Output includes the final end moments of each member, and the number of iterations.

Machine Details: Programmed in S.O.A.P. using approximately 1,5550 locations of memory. Running time approximately 0.1 second per member per joint per iteration.

Availability: Available through IBM Program Library, 590 Madison Avenue, New York, N. Y.

Division Doings

Engineering Mechanics Division

A wide range of applied mechanics subjects will be discussed at the **1960 West Coast Conference on Applied Mechanics,** to be held at the California Institute of Technology, Pasadena, June 27-29. The conference takes place annually under co-sponsorship of the West Coast Committee of ASME and the West Coast Committee of the ASCE Engineering Mechanics Division. Its purpose is to promote the presentation of original research in the applied mechanics field, including linear and nonlinear mechanics, dynamics, vibrations, plates and shells, elasticity, plasticity, visco-elasticity, and properties of materials.

Last year's conference at Stanford was an outstanding success, with an attendance of over 200 specialists in applied mechanics from England, Germany, Canada, and the United States. With the exception of a few papers submitted directly to the conference, the ASCE conference contributions are selected from papers submitted to the Engineering Mechanics Division Journal.

Prof. James M. Gere, of Stanford University, is chairman of the ASCE West Coast Committee for 1960, and Prof. B. J. Hartz, of the University of Washington, is secretary.

Hydraulics Division

Plans are well underway for the **ninth annual conference of the Hydraulics Division,** to be held in Seattle, August 17-19. Technical sessions have been scheduled in six areas—hydraulic structures, hydro-mechanics, tidal hydraulics, sedimentation, flood control, and hydrology. Tours and a pleasant social program are also being arranged. Co-hosts for the conference are the ASCE Seattle Section and the University of Washington. The program will be held on the university campus. Prof. Eugene P. Richey is general chairman.

Increased salinity of ground-water aquifers by intrusion of salt water is one of the nation's major ground-water problems in the opinion of the Division's newly established **Committee on Ground Water Hydrology.** At a recent meeting in Denver the committee considered the seriousness of intrusion in both coastal and inland aquifers and decided to organize a task force to concentrate on devising methods of control. Current research projects in the field were summarized, and plans were made for sponsoring sessions at ASCE Conventions. D. K. Todd is chairman of the committee.

The **new emphasis on water resources in ASCE** was the subject of a report of the Division's executive committee, presented at the New Orleans Convention by C. E. Kindsvater, vice-chairman of the committee. Because of the tremendous importance of water resources planning in the national economy, the Board of Direction (in 1957) appointed a task force on water resources—headed by the late Past President W. W. Horner. As a result of the recommendations of the Horner Committee and its successor committee—the Water Resources Coordinating Committee—the Hydraulics Division has reorganized its structure and appointed new committees in order to serve better in the field of water resources.

Four other Technical Divisions—Irrigation and Drainage, Power, Sanitary Engineering, and Waterways and Harbors—were reported as carrying on expanded and accelerated programs in the field of water planning and conservation.

Pipeline Division

The March meeting of the Los Angeles Section was sponsored by the **Pipeline Division** and the relatively new Los Angeles Pipeline Group. It was the first Local Section meeting put on by the **Pipeline Division.** Present plans call for the Pipeline Group, which has grown tremendously since its formation in June 1959, to sponsor at least one Section meeting annually. Following the social hour and dinner George B. McMeans, vice-president of operations at the Kaiser Steel Corporation, spoke on basic oxygen steel making at Kaiser's Fontana Mill.

Structural Division

Six major manufacturers of data-processing equipment will exhibit their machines at the **Second National Conference on Electronic Computation,** to be held at the Pittsburgh-Hilton Hotel, September 8 and 9. The conference is sponsored jointly by the Committee on Electronic Computation of the Structural Division and the Pittsburgh Section. Charles Zahler, chairman of the Section's Exhibit Committee, has arranged for the exhibits. The Pittsburgh Section extends a cordial invitation to engineers to attend the Conference. It has set up several committees to make their stay in Pittsburgh pleasant and informative.

The Construction Division Executive Committee met in New Orleans at the time of the Convention. In usual order are Walter Couse, contractor of Detroit; Lyman Wilbur, vice president and chief engineer of Morrison Knudsen Inc., Boise, Idaho; Joseph F. Jelley, Jr., construction consultant of Colorado Springs, Colo.; and Carl B. Jansen, president of the Dravo Corp., Pittsburgh.

A Structural Division session at recent New Orleans Convention had as speakers T. Y. Lin, of Berkeley, Calif., at left; Philip M. Grennan, of New York; R. D. Dewell, of San Francisco, who presided; and John B. Skilling, of Seattle, Wash.

Large Dams Group to Meet at Reno Convention

The Society's Reno Convention program (printed in its entirety in this issue) will feature joint sessions with the United States Committee on Large Dams. The U. S. Committee on Large Dams is the American segment of the International Congress on Large Dams, in which 44 nations of the world participate. It will hold joint sessions with ASCE's Construction, Power, Hydraulics and Soil Mechanics & Foundations Divisions, and will combine with the Power Division in a field trip to the Upper American River project.

Together with the emphasis on problems related to dams, engineering aspects of other water matters will occupy considerable attention at the meetings. The Waterways & Harbors and the Irrigation & Drainage Divisions will each sponsor four sessions, at which a total of 27 papers will be presented. Several of the papers will be concerned with the conversion of seawater for domestic, agricultural, and industrial purposes, and the problems involved in the utilization of land with a saline content.

The Sanitary Division will hold three sessions, as well as a joint session with the Construction Division. Three joint sessions also will be sponsored by the Soil Mechanics & Foundations Division and the Structural Division. Another joint session is planned by the Structural Division with the Structural Engineers Association of California, which will feature a panel discussion of the revised seismic code developed by the state seismology committee of the Structural Engineers Association.

In addition to the Power Division-USCOLD field trip, other field inspections are planned by the Sanitary Division to the Squaw Valley sewage treatment plant; the Pipeline Division to the Sparks facilities of the Southern Pacific Pipe Line Co., at Sparks, Nev.; and the Highway and Construction Division on a tour of Nevada and California highways.

The Sacramento Section of ASCE and its Nevada Branch are hosts for the Reno Convention. General chairmen for the meeting are R. Robinson Rowe and Dean Howard B. Blodgett. Program chairman is Stewart Mitchell.

John H. Fisk Joins Headquarters Staff

John H. Fisk, A.M. ASCE, has joined the ASCE headquarters staff as an Assistant to the Secretary, after two years in the Structures Department of Howard, Needles, Tammen & Bergendoff. Mr. Fisk was first connected with the New York consulting firm for a period of six months following his graduation from Rutgers University in 1954. He then spent three years as a pilot in the U.S. Air Force with the rank of lieutenant. At Rutgers he was holder of a university scholarship and a member of the ASCE Student Chapter. He is currently attending night classes at Newark College of Engineering, working for a master's degree in management engineering.

As Assistant to the Secretary, Mr. Fisk will work with the Student Chapters and younger members and do some Convention work. He lives at Franklin Park, N. J., with his wife and two young sons.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closed May 1, 1960. See 1960 Official Register, page 149. Topic for 1961 contest to be announced later.*
FREEMAN FELLOWSHIP:	*1961 contest to be announced. See Official Register, page 154.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1961-62 contest closes April 1, 1961. See Official Register, page 156.*
RESEARCH FELLOWSHIP:	*1961 contest closes Jan. 1, 1961. See Official Register, page 156.*
ERNEST E. HOWARD AWARD:	*Closing date Feb. 1, 1961. See Official Register, page 148.*

Policy on Public-Private Engineering Services Modified

A basic policy statement on "Relationship Between Public and Private Engineering Services in Government Agencies" was published in the January issue of Civil Engineering, page 68. An agency of Congress, commending the statement for its impartiality, subsequently asked for amplification of two points, which were covered in appendixes that were carried on page 37 of the February number of Civil Engineering. The entire statement was confirmed by the Board of Direction on March 7, 1960.

Spirited protests from Society members in the Corps of Engineers were received following the publication of the two appendixes. About 200 names were listed in the six petitions filed, along with a few individual letters.

The objections were almost entirely centered upon Appendix II, a listing of advantages to be derived from the proper usage of consultants. Appendix I defined a term "minimum constant load," as used in the basic statement.

The District 10 Council, while endorsing the basic policy, urged that the Board of Direction reconsider the appendixes.

Responsive to the grass-roots reaction, the Executive Committee reviewed the entire question on April 22. Noting that neither of the two appendixes was essential to the intended interpretation of the basic policy, it was voted to delete both of them and to retract them by appropriate notice to everyone who had received the complete statement.

It is of interest to note that some comments have been received from consulting engineers on the premise that the policy was not adequate from the standpoint of private practice. The Executive Committee considers that the basic statement does present the philosophy that the public interest is paramount in any decision between public and private engineering service. Competent administrators of public engineering bureaus, equipped with complete and accurate cost data, can make these decisions.

Engineers to Meet In the Argentine

This September Argentine engineers will be host to two important meetings—the Pan American Congress on Engineering Education (September 12-16) and the Seventh Convention of the Pan American Association of Engineering Societies (September 19-23). Both meetings, which will take place in Buenos Aires, will provide opportunities for engineers of the entire hemisphere to get together in technical and business sessions and contribute to the profession.

As chairman of the Committee on International Relations of Engineers Joint Council, Gail A. Hathaway, Past President of ASCE, urges engineers planning trips to South America to keep these dates in mind and arrange to join the U.S. delegation at both meetings. Says Mr. Hathaway, "This will be a splendid occasion to get to know our colleagues in Latin America and to work with them on projects of mutual interest."

Ralph Rumer, Jr., Wins ASCE Research Fellowship

As announced in the April issue, Ralph R. Rumer, Jr., A.M. ASCE, has been appointed ASCE Research Fellow for

the 1960-1961 academic year. He is a graduate student at Massachusetts Institute of Technology, pursuing a program leading to the doctor of science degree. With his $5,000 grant he will conduct a research program, in the M.I.T. Hydrodynamics Laboratory, concerned with analytical and experimental investigation of diffusion and gravitational convection in liquids of different density in porous media.

A 1953 graduate of Duke University, Mr. Rumer was secretary and president of the ASCE Student Chapter there. For outstanding achievement as an undergraduate he was awarded the North Carolina Section's prize of Junior Membership in the Society. While working for his master of science degree at Rutgers University Mr. Rumer taught in the civil engineering department there—first as assistant instructor and then as instructor. He received his master's degree in June 1959.

The award to Mr. Rumer represents the second award of the Research Fellowship, which was established in 1958 by the Board of Direction for "the purpose of aiding in the creation of new knowledge" for the benefit of the profession. The grant is made from current Society income.

ASCE Membership as of April 8, 1960

Fellows	10,908
Members	15,903
Associate Members	18,065
Affiliates	94
Honorary Members	47
Total	45,017
(April 9, 1959	42,574)

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.38	1.13
Baltimore	1.14	1.14
Boston	1.22	1.22
Chicago	1.45	1.43
Denver	1.24	1.21
Houston	1.26	1.26
Kansas City	1.13	1.16
Los Angeles	1.28	1.23
Miami	1.57	1.57
New Orleans	1.18	1.18
New York	1.25	1.28
Pittsburgh	1.07	1.04
Portland (Ore.)	1.27	1.25
San Francisco	1.30	1.24
Seattle	1.06	1.06

Highway Departments

Region	Current	Previous
I, New England	1.01	0.90
II, Mid Atlantic	1.14	1.14
III, Mid West	1.27	1.22
IV, South	1.12	1.14
V, West	1.06	1.03
VI, Far West	1.17	1.13

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II, and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in Civil Engineering. Latest survey was January 30, 1960.

The Younger Viewpoint

This month, Donald Kowtko of Zone 1 steers the column with substantial propulsion furnished by concerned Civil Engineers.

"Associate" officially replaces "Younger"—ASCE has now officially renamed the Younger Member Forums, the Associate Member Forums. This is a good move toward professional enhancement in our opinion. (M.A.)

More on P.E. Exams—Also concerned with professional enhancement is Consulting Engineer Raphael G. Kazmann, of Stuttgart, Ark. He writes:

"It is my opinion that, in protecting the public's life, health, or property, the most important factors are the character, judgment, and skill of the engineer, not his ability to solve arithmetical problems under a stopwatch. After all, if the engineer can't solve the specific arithmetical problem, being a man of character and judgment, he'll find someone who is able to.

"If an exam is supposed to enable a Board to know that a license should be granted, the problems set forth by the Board should enable the examinee to display judgment, if not character. Let me call your attention to the December "Exam Gem," taken from an actual examination, as an illustration:

" '*Given:* Plan A calls for an initial investment of $300,000 and expenditures of $10,000 a year for the first 20 years and $20,000 a year thereafter. It also calls for the expenditure of $200,000 at a date 20 years hence and every 20th year thereafter.

" 'Plan B calls for an initial investment of $500,000 followed by a single investment of $100,000, 30 years hence. It also involves periodic expenditures of $50,000 every 10 years.

" '*Required:* Compare Plan A and Plan B on the basis of the capitalized cost of perpetual service, using interest at 4 percent!' "

"This problem could properly be programmed for a digital computer, the effect of various interest rates might be studied, and the effect of inserting the prime money rates in actual order of occurrence during the past 30 years might also be studied. (We can afford to do a little work for a potential $200,000 saving in capital investment.) If the client were a private firm the effect of corporate taxes should be taken into account, as well as depreciation policy. Most important: What are the chances that one or the other, or both, of the alternatives will become technically obsolete and uneconomic in less than 20 years? Considering the rate of technologic progress, this is most probable. There is no hint in this problem that these points should be considered by the engineer. The element of judgment has been completely removed, consequently there is no reason to believe that the ability to solve such a problem is any indication that the public will be safe in the man's hands.

"However there is one other possibility: the Board might consider that any answer *except*, 'This is a nonsensical engineering problem,' would be sufficient reason to withhold permission to practice, on the grounds of demonstrated lack of judgment by the applicant.

"Engineering will become a recognized profession when the attitudes, 'One engineer is as good as another,' and, 'Engineers? Why, they're a dime a dozen,' are abandoned by the public. And these attitudes can be expected to remain as long as engineers are licensed on the basis of solving complicated arithmetical problems rather than solely on the basis of character, education, experience and professional achievement. You shouldn't be able to increase the number of professional engineers by sponsoring a cram-course.

"Inasmuch as the practice of engineering, the application of physical principles, and the exercise of judgment do not vary from state to state, is there any valid reason why any registered engineer, who did not obtain his registration under a 'grandfather' clause, should not be entitled to practice anywhere in the United States by reciprocity?"

Re: Engineer Graduate Recruiting—Student Miedtke's letter, published in the March issue of CIVIL ENGINEERING, has drawn a response from an "older" member of ASCE, Donald A. Walsh, of the Illinois Section. Excerpts from Mr. Walsh's letter follow:

In answer to Mr. Miedtke's question, 'How do we find an opening in this field?' (consulting and construction), the answer is simply that you go out and look for it. Within a few pages of where his question appears, there is listed in the Professional Services Index of CIVIL ENGINEERING over 100 of the largest and best consulting and engineering firms in the world. . . .

"I am sure a letter to any of these companies in which the student outlined his educational background, personal history, and experience record, would receive a reply and probably several job offers. Some firms will pay the travel expenses of a good prospective employee to the company's offices for a personal interview.

"It would seem to me that engineering students have been pampered too much in recent years and expect to have jobs handed to them with little or no effort on their part. Mr. Miedtke seems to feel that letters would take up too much valuable time of the various employers. I do not believe that the volume of such mail that would go to any one firm would be of suffiicient magnitude to cause concern. Many large companies are located in the large metropolitan areas which also contain the educational institutions that produce the engineers. Certainly an enterprising young man would know how to pick up a phone and call some of these companies and arrange for an interview. Regarding his suggestion that some type of employment agency be set up by ASCE . . . such an agency not only exists and has for some years, but it is anxiously looking for the 'right peg to fit into the right hole.' This agency is called the Engineering Societies Personnel Service, and some of the 'pegs' and 'holes' are also listed in CIVIL ENGINEERING a few pages from where Mr. Miedtke's letter appeared. I am sure the E.S.P.S. would be glad to accommodate interested students. . . .

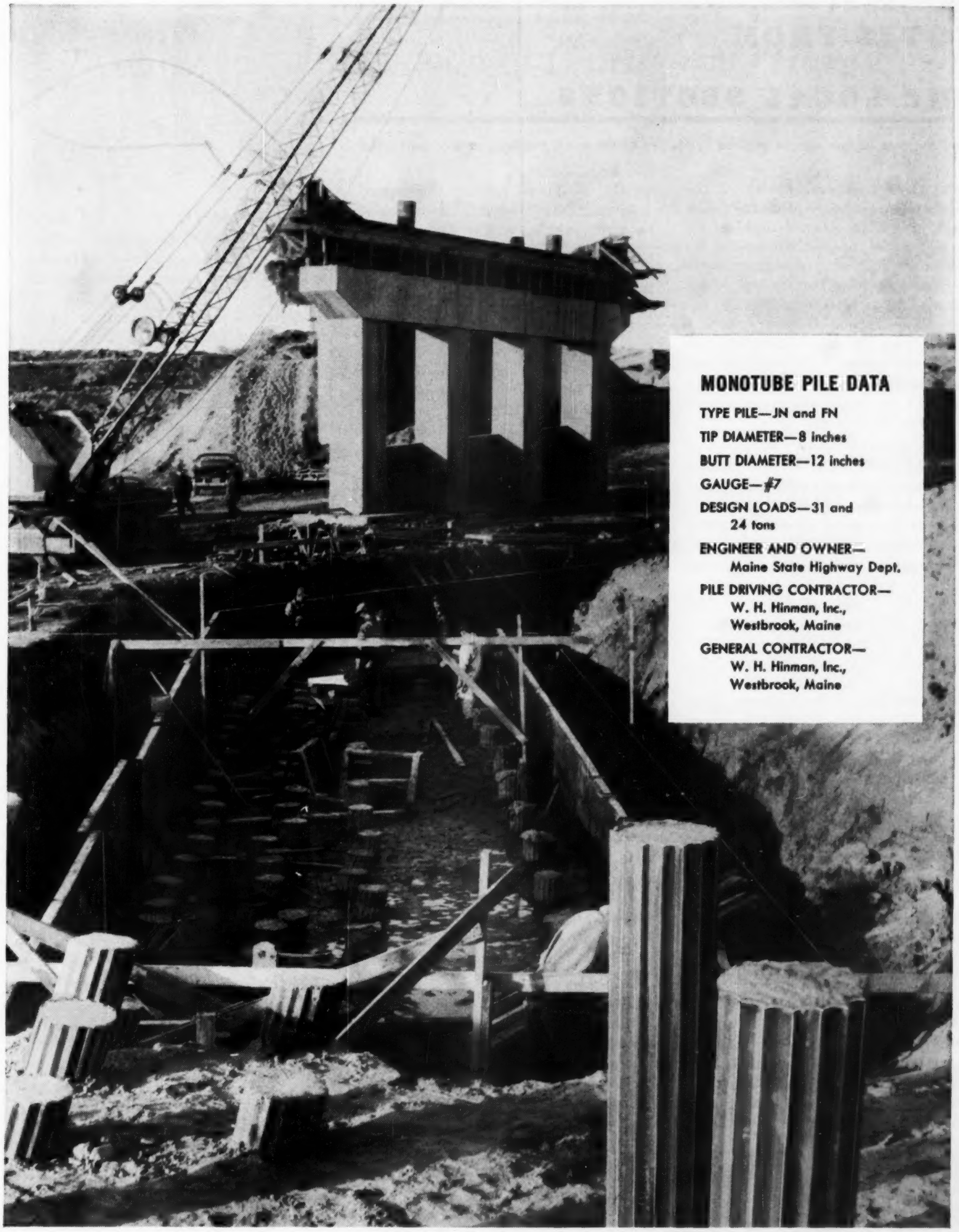
"It seems to me that young engineers make too much of an issue on the matter of security in seeking employment. Any young man in his twenties who is seeking a secure job to the exclusion of other considerations is in all probability a rather mediocre individual who will never realize the full fruition of his educational efforts. The young engineer should take his first jobs to gain experience and find what type of work he is best suited for. The more diversified an engineer is the more valuable he is to himself and to the company he finally decides to stay with.

In summary, I would like to say to Mr. Miedtke that, "I am sure that getting a job entirely through his own efforts will prove a very rewarding and valuable experience for any young engineering graduate.

Committee on Younger Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	Walter D. Linzing 4751 No. Paulina Chicago 40, Ill.	Judd Hull 3178 Almeria San Pedro, Calif.



STRENGTH AND STABILITY with cold-rolled Monotube steel piles for this skew bridge, Portland, Maine. High yield-strength Monotubes overcome severe driving conditions and resist horizontal forces inherent in skew bridge design.

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UNION METAL

Monotube Foundation Piles

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

The **Cape Canaveral Branch** of the **Florida Section** recently presented a cash award of $25 to Kenneth Laretto, of Cocoa, Fla., for the most outstanding exhibit in the field of civil engineering at the Regional Science Fair for high school students held at Melbourne, Fla. His exhibit, "Algebra and Geometry in Extended Span Bridges," included two scale model bridges with analytical and graphic analysis of structural members. Kenneth is headed for the Massachusetts Institute of Technology.

The **Albany Branch** of the **Georgia Section** has named new officers to fill the vacant posts of vice-president and secretary-treasurer, created when the previous officers, Nelson Goetz and William Galloway, moved away from the Albany area. For the remainder of the year Thomas W. Tucker will serve as vice-president, and Plato Collins as secretary-treasurer . . . "Civil Engineering Challenge in the '60's" was the title of the address given by Col. Raymond L. Hill, general manager of the Diamond Construction Company, before the March meeting of the **Savannah Branch.** Colonel Hill pointed out that this is the century of material development, and that the next will be a century of intellectual development. Therefore, the engineer must develop methods in the '60's to meet the challenge of the scientists' new discoveries.

Once again the **Hawaii Section** is conducting a preparatory course at the University of Hawaii for the Professional Engineers State License Examination to be given in August. The cost of being "refreshed" is $70 to ASCE members and $80 to non-members. Prof. L. Scott Daniel is in charge of the program.

A topic of tremendous importance to the Chicago area was discussed at the March 11 luncheon meeting of the **Illinois Section.** Norval E. Anderson, engineer of treatment plant design for the Metropolitan Sanitary District of Greater Chicago, spoke on the "Present Implications of the Lake Diversion Suit." The suit was brought by states bordering on Lake Michigan to compel the Sanitary District to return its treated effluent to the lake because of loss of power and navigation capacity. The suit followed a proposal to allow the Sanitary District to divert an extra 1,000 cfs from the lake for a trial period of a year.

A 50 percent reduction in the weight of highway culverts and like corrugated metal structures can be effected through better engineering and closer supervision of the installation of these structures, L. Henry Klosterman, a senior sales engineer for Armco Drainage and Metal Products Company, told the membership of the **Lehigh Valley Section** at its February meeting. Mr. Klosterman advanced a theory for analyzing the compressive forces in a thin circular or eliptical shaped ring such as is used in culvert design.

At the University of Alaska Prof. E. F. Rice (left), president of the Alaska Section, and Student Chapter officers—Pete Weimer, Ronald Thiel and Ronald Jaworek—confer with ASCE Executive Secretary Wisely, in center. At right is Robert Crow, president of the Fairbanks Branch. At Branch meetings in Fairbanks, Anchorage, and Juneau in early winter Mr. Wisely met more than two-thirds of the ASCE members in Alaska. He gave the groups information on current activities of the Society and first-hand answers to questions on policy and practice.

Brig. Gen. Herbert D. Vogel (left), since 1954 chairman of the board of the Tennessee Valley Authority, told a recent luncheon meeting of the Panama Section about the TVA. Shown with him is Col. John D. McElheny, Lieutenant Governor of the Canal Zone and vice-president of the Panama Canal Company.

LOCAL SECTION MEETINGS

Georgia—Luncheon meeting postponed from March 4 to May 20 at 12:30 p.m.; regular monthly dinner meeting at the American Legion Hut in Chastain Park on June 9; regular meetings of the Structures Division on the third Friday of each month.

Illinois—Weekly luncheon meetings at the Engineers' Club in Chicago every Friday, at 12 noon.

Intermountain—Regular monthly meetings on the fourth Friday of each month; evening meeting of the Southern Utah Branch at the Columbia Iron Mining Company Office Building in Cedar City on May 18, at 7:30 p.m.

Los Angeles—Reception and dinner meeting of the Younger Member Forum at the Engineers' Club (Room 3333) in the Biltmore Hotel on May 26, at 6:30 p.m.

Metropolitan—Regular meetings in the Engineering Societies Building on the third Wednesday of each month, at 7:00 p.m.

Philadelphia—Spring social at the Bala Country Club in the Delaware Valley on May 14. Checks for tickets to Mrs. Theodore Davis, 101 Loller Road, Hatboro, Pa.

Sacramento—Weekly meetings at the Elks Temple every Tuesday, at 12 noon.

San Francisco—Meeting of the Construction Division at Spengers Fish Grotto in Berkeley on May 19, at 6:00 p.m.

South Carolina—Spring meeting at Clemson House in Clemson, May 13-14.

(Continued on page 90)

A-M Flat-Base Pipe used in $120,000,000 expansion of Chicago's O'Hare Field

Contractor for installation of this A-M Flat Base watermain gallery: S. J. Groves, Chicago; Architects-Engineers: Naess & Murphy, Chicago.

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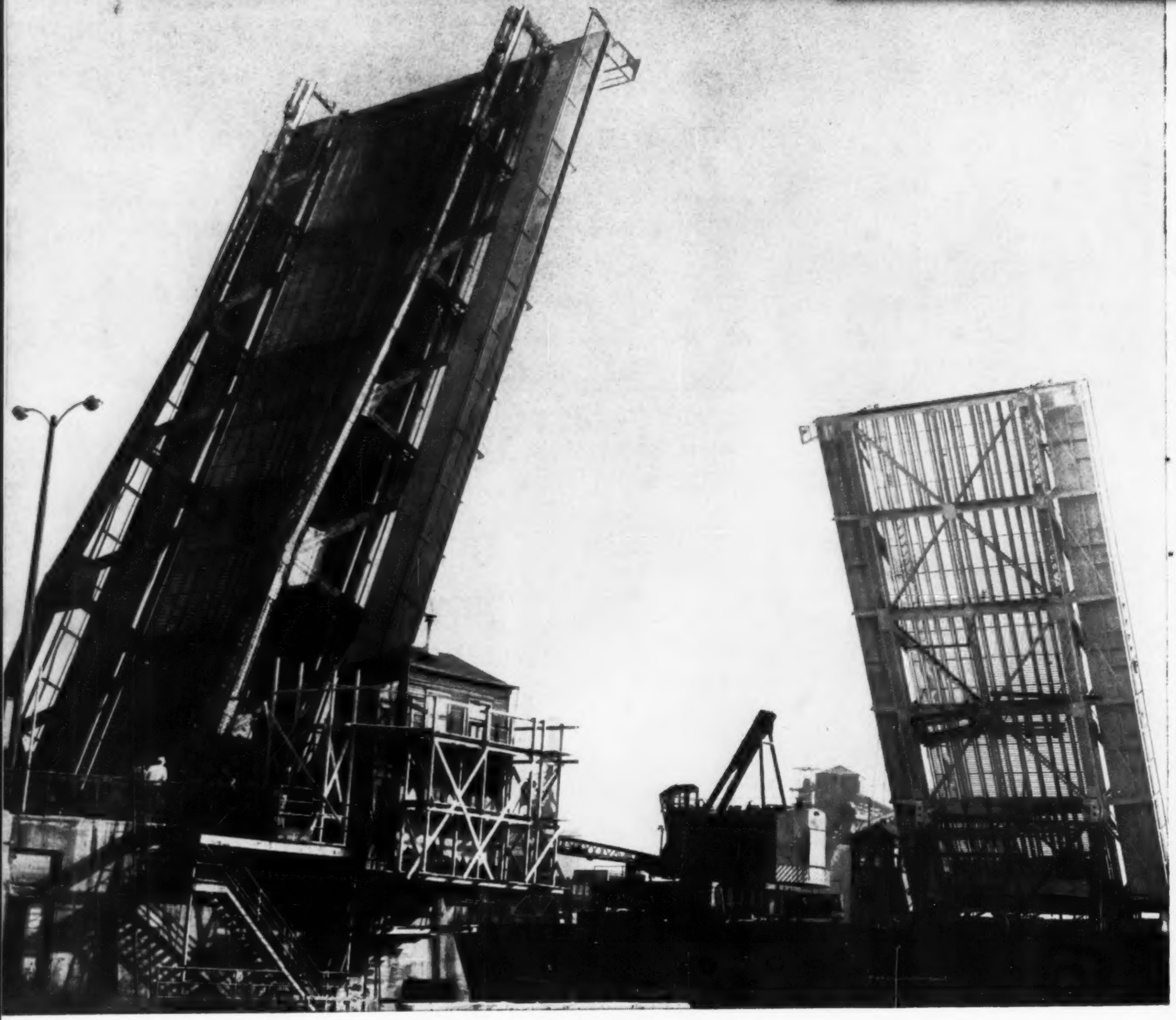
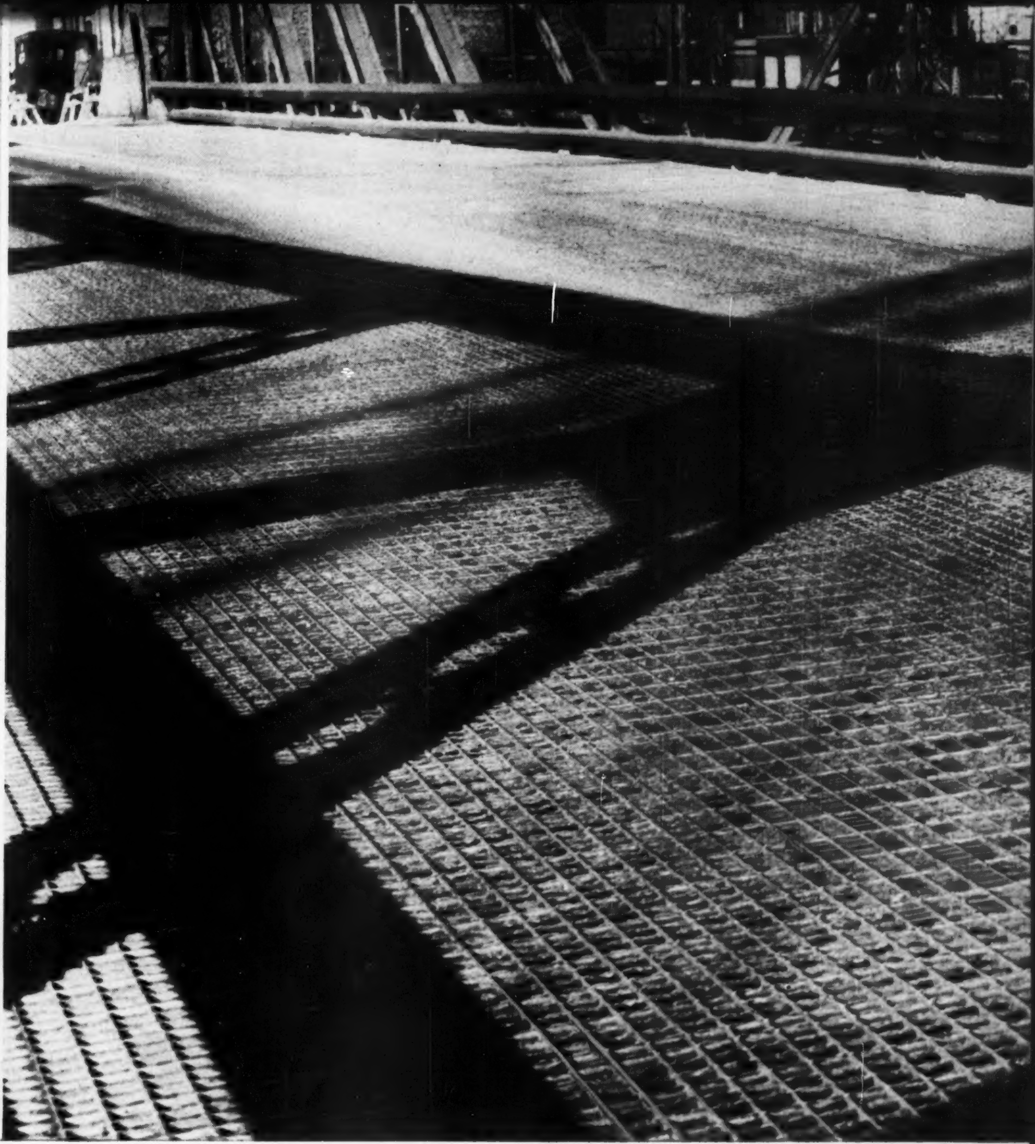
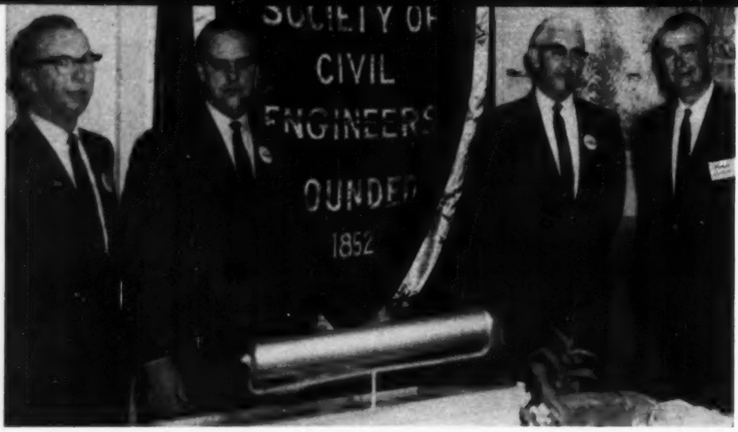
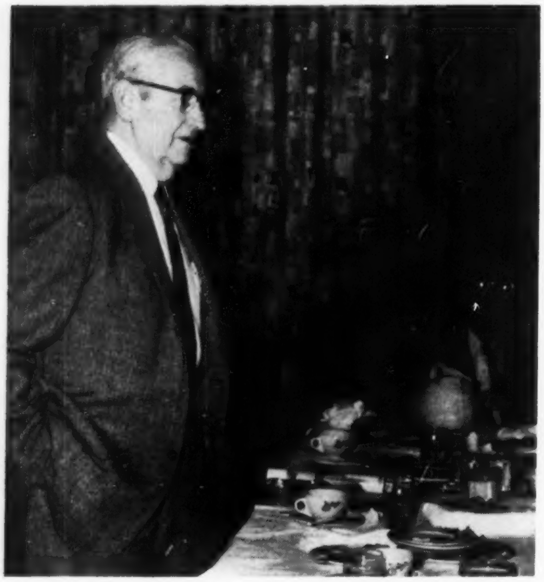


How to add 20 years to the life of a bridge



At Ladies Night dinner meeting of the Los Angeles Section's Orange County Branch new Branch officers were installed. They are (left to right) Joseph Truxaw, vice-president; Floyd McLellan, secretary-treasurer; and James Ballinger, president. Norman Hume (far right), Section vice-president, conducted the ceremonies.



Ernest H. Stork, director of public service for Columbus, Ohio, in a recent address before the Central Ohio Section envisioned Port Columbus as becoming the country's model jet airport. A logical step, he said, is the establishment of a port of embarkation so that international flights can originate there.

The Central Illinois Section met recently at the University of Illinois to elect officers for 1960. Outgoing President P. L. Zumwalt (left) posed with the new officers (in usual order), H. O. Scheer, first vice-president; J. D. Haltiwanger, secretary-treasurer; W. J. Roberts, second vice-president; and C. E. Kesler, president.

(Continued from page 86)

With this compressive force known, it is possible to design a culvert with a factor of safety half that used in corrugated metal handbooks, providing the backfilling of the structure is carefully controlled.

Maine Section members and guests, including 30 members of the University of Maine Student Chapter, held an early spring meeting at Dow Air Force Base, which was highlighted by a tour of a nearby Bomarc missile base in the afternoon. The luncheon speakers were Col. Henry J. Clerici, Base Commander, who also showed a film on Strategic Air Command operations, and LeRoy H. Collegeman, senior resident engineer for the Boeing Airplane Company, who showed a film on the Bomarc missile and gave a talk on the Bomarc installation and its part in the defense system.

The past, present, and possible future of American highways unfolded for the membership of the **Jackson Branch** of the **Mid-South Section** at the March dinner meeting. "Magic Highway—U.S.A.," a sound and color film produced by the Walt Disney Studios, traced the development of transportation facilities in the United States from the days of the covered wagon, to our modern turnpikes and thruways, finally passing into the realm of fantasy and the possible future of our highway system. President Alex Harris concluded the meeting with some interesting statistics on the highway system and motor traffic.

The whys and wherefores of the revitalization of Portland's downtown area was highlighted at a recent **Oregon Section** meeting by speaker Lloyd Keefe, executive secretary of Downtown Portland, Inc. Mr. Keefe pointed out that the idea, what is good for the downtown area is good for the city as a whole, is a valid one, inasmuch as 30 percent of the city tax base and 25 percent of the county tax base come out of the area. Hence, a small drop in the assessed valuation of the downtown area would result in fairly large tax increases on many taxpayers' homes in order to raise the same amount of tax money.

The **Philadelphia Section** was pleased at the large turnout of guests and senior civil engineering students of area colleges who attended the recent symposium conducted by the Section's Associate Member Forum on the eight-story precast concrete A. N. Richards Medical Research Building. The building, erected on the campus of the University of Pennsylvania, is unique in its integration of aesthetics and structural framing method, materials and erection technique; space-form evolvement; and the coordi-

(Continued on page 96)

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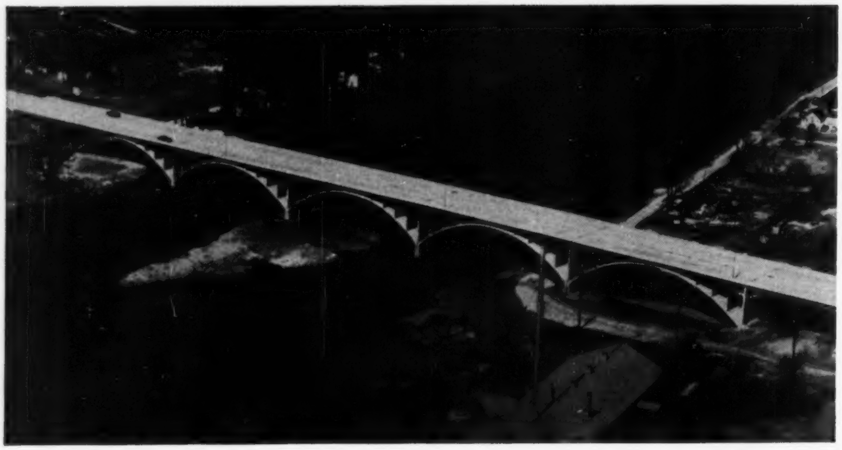

The design flexibility of reinforced concrete permitted designers of this highway bridge to achieve the grace and beauty of thin barrel arch spans.

Northern Illinois Toll Highway Bridge
Designers: Vogt, Ivers, Seaman & Associates, Cincinnati, Ohio
Consulting Engineer: Joseph K. Knoerle & Associates, Baltimore, Md.
General Contractor: CKG Associates, Elgin, Illinois

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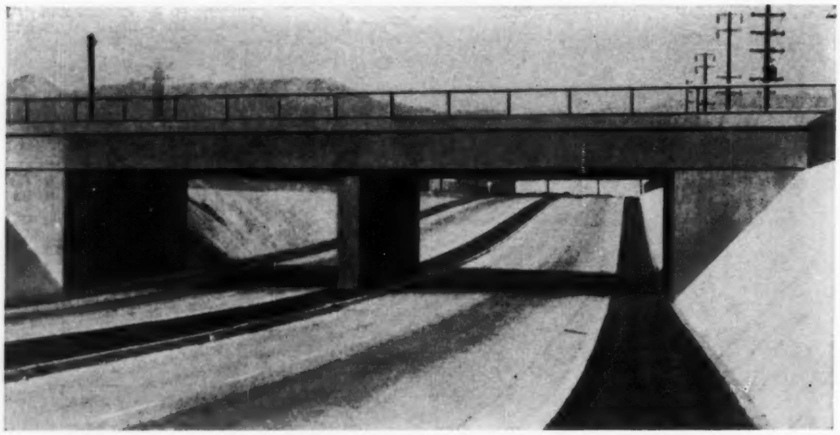
Regardless of structural requirements, reinforced concrete offers greater design freedom, economy, and speed of erection. Its flexibility permits the construction of intricate or complicated designs and simplifies the problems of varying elevations and terrain. And because of the ready availability of materials from local sources, your projects start on time—finish on schedule. Specify reinforced concrete for your next project and take advantage of its many design and construction benefits.



For maximum construction economy in this railroad bridge, designers specified a cored-slab, cast-in-place bridge deck with a rigid frame structure of reinforced concrete.

Santa Fe Railroad Bridge
Designers: County of Los Angeles Road Department
Contractor: Otis B. Pierson Construction Company

Speed of construction and availability of materials permitted contractors on this reinforced concrete highway interchange bridge to complete the project ahead of schedule.

U.S. Highway 23 Interchange
Designer: Michigan State Highway Dept.
General Contractor: Walter Toebe & Co. Lansing, Michigan

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CRSI
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Concrete Reinforcing Steel Institute
38 S. Dearborn St.
Chicago 3, Illinois

6-6

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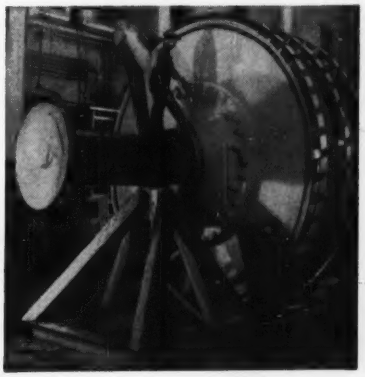

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Moreover, Newport News' plant provides unsurpassed facilities. More than 225 acres in area, it comprises vast steel fabricating shops, five huge machine shops, acres of pattern shops and foundries. It includes forge and die shops, heat treating furnaces and allied equipment, along with complete modern test apparatus.

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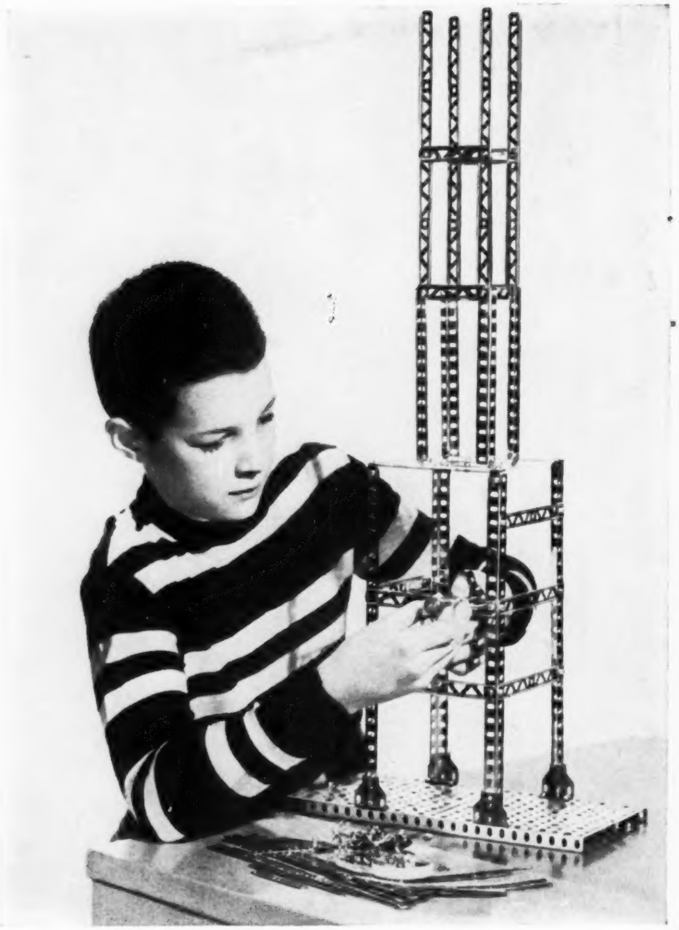
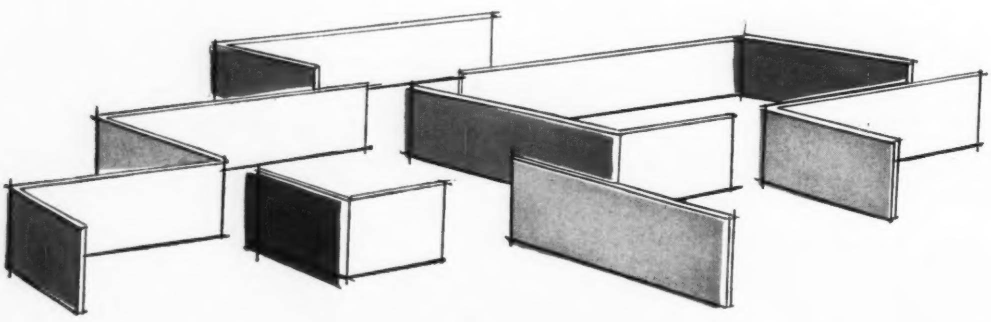
Newport News, Virginia

What structural material for schools?



arrives at the site ready to go up fast!



adapts to many fire-resistant constructions!

costs less per pound than a loaf of bread!

lends itself to easy expansion!

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All these advantages hold true not only for schools, but also for plant and office buildings, bridges, churches, houses, shopping centers. Remember, too, that both steel producers and steel fabricators have expanded facilities. That means you can get all the fabricated structural shapes you need—when you need them.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

(Continued from page 90)
nation between utility and accessibility cores to operational areas. The layout theme evolved by architect Lewis Kahn, one of four speakers on the panel, was to employ "vertical corridors" between laboratories, or studios, instead of the conventional horizontal plan. Interconnecting sub-towers act as corridor media, while several additional sub-towers are placed at prescribed positions along the perimeters of the main towers and the central core. These serve as air intake and exhaust chambers for each laboratory —a noteworthy accomplishment because of the formidable amount of chemical gas exhausts to be expected in isotope research work. Thomas Leidigh, of the consulting engineering firm, Keast and Hood, described the structural aspects of the building, while Joseph R. Farrell, Jr., and James Morrisson, of the Joseph R. Farrell Construction Company, general contractor, illustrated, with running commentary, a movie showing construction sequences of the unusual job.

At a recent meeting the **Seattle Section** installed officers for 1960. Wellington Rupp is the new president; Carl M. Berry, vice-president; Robert W. Seabloom, secretary; and Leland H. Sphar, treasurer. At the same meeting Life Membership Certificates were presented to Walter H. Starkweather and Paul M. Trueblood. The program consisted of a talk on the comparison of the educational systems in Germany and the United States by George Goble a former Fulbright scholar and now a doctoral candidate in civil engineering at the University of Washington.

Julian B. Shand, consulting engineer of Columbia, S. C., was recently elected president of the **South Carolina Section.** Preceeding his election S. C. Brissie, superintendent of District 4 Schools, Woodruff, S. C., spoke on "Preparing High School Students for Engineering." Robert C. Blair, manager of the Savannah River Operations Office of the Atomic Energy Commission, spoke next on "Atomic Power—Present and Future," followed by a talk on "Reinforced Concrete Thin Shells" by R. A. Shoolbred, regional structural engineer of the Portland Cement Association, Atlanta, Ga.

John R. Alspach (left), Lucas County (Ohio) engineer, answers questions posed by Harry W. Grell, Jr. (center), Toledo Section president and Robert Brannan, following his talk to the Section membership on Toledo's ever-expanding expressway system.

Discussing plans and programs are the 1960 San Francisco Section officers. Shown, left to right, are: R. Kennedy, vice-president; B. Nishkian, vice-president; John Blume, president; R. Lawson, secretary; and J. McCarty, treasurer. Those attending the installation meeting also heard a talk by Col. J. S. Harnett on how model studies of the San Francisco Bay will affect future flood and silting construction programs for the Bay.

ASCE CONVENTIONS

RENO CONVENTION

Reno, Nev.
June 20-24, 1960

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

PHOENIX CONVENTION

Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

DISTRICT CONFERENCES

PACIFIC SOUTHWEST COUNCIL

Reno, Nev.
June 20-24, 1960

TECHNICAL DIVISION MEETINGS

RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS

Boulder, Colo.
University of Colorado
June 13-17, 1960

Sponsored by

Soil Mechanics and Foundations Division

WEST COAST CONFERENCE ON APPLIED MECHANICS

Pasadena, Calif.
California Institute of Technology
June 27-29

Sponsored by

Engineering Mechanics Division

HYDRAULICS CONFERENCE

Seattle, Wash.
University of Washington
August 17-19, 1960

Sponsored by

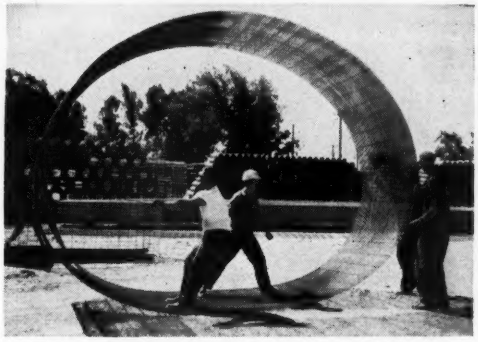
Hydraulics Division

CONFERENCE ON ELECTRONIC COMPUTATION

Pittsburgh, Pa.
Hilton Hotel
September 8-9, 1960

Sponsored by

Structural Division



USS American Welded Wire Fabric conforms perfectly to the elliptical shape of the 144" pipe. Because of the machine prefabricated accuracy of USS American Welded Wire Fabric, cages can be formed faster, and the spacing and concentricity of cages can be accurately controlled.

strengthen concrete pipe on Michigan Highway job

The Michigan State Highway Engineers faced a problem when it came to the selection of pipe for an important new highway in Berrien County. Hydraulic and grade line considerations dictated pipe with maximum water-carrying capacity with a low flow line, but with up to 33 feet of back fill. They selected over 1,000 linear feet of elliptical, reinforced concrete pipe. Diameters varied from the smallest to the largest—18" to 144".* Lamar Pipe & Tile Division, American-Marietta Company, manufactured the pipe.

In the case of the 480 feet of 144" required to withstand 33 feet of backfill, the specifications required 3 lines of reinforcement—an inner and outer cage each having 0.754 square inches per foot, and an elliptical cage having an area of 1.508 square inches per foot. Lamar Pipe & Tile elected to use American Welded Wire Fabric on this big job.

Concrete pipe manufacturers insist on quality reinforcing, meeting rigid specifications—that's why so many of them use USS American Welded Wire Fabric. This quality product—with its machine-made accuracy, assures the proper distribution of steel because the wire diameters are held to the close tolerance of ±0.003" and their spacing may not vary by more than ¼" center-to-center. This prefabricated product is more accurate than other forms of reinforcing. Its cold-drawn, high-tensile steel wires have a minimum yield point of 60,000 psi and a minimum ultimate strength of 75,000 psi. For more information, write to American Steel & Wire, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

*Round equivalent

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To increase the strength of the pipe, by resisting diagonal tension, 320 ⅜" diameter stirrups are attached through the three cages of USS American Welded Wire Fabric.

BY-LINE WASHINGTON . . . . .

The Army's Corps of Engineers is quietly moving into two areas of **U.S. space-exploration programs:** Mapping and geodesy of the earth and a study of what kind of construction is needed—and how to build it—on other worlds. Corps' officers, who are careful to say that their studies are informal, believe the problem of construction on another world represents a serious gap in space work, since structures for the moon, for instance, may take as much planning and work as it will take to plan and build the vehicle that will land astronauts there. Mapping is being pushed now, through triangulation of artificial satellites, to obtain more exact location of points on the earth's surface.

* * *

There will be further strong competition from the Federal Government this year for the **services of young engineers and technicians.** The Civil Service Commission has recently approved raises averaging more than $400 yearly for entering pay grades in two categories (GS-5 and 7), bringing them up to $4,940 and $5,880, respectively. Reason: The government will recruit some 3,200 engineers during the next year.

* * *

Inland waterway navigation interests are in dead earnest in their plan to present united opposition to any attempt to lower navigation clearances of highway bridges, despite the efforts of highway people to do just that. The waterways men held a strategy meeting in Minneapolis on April 21 to plan their campaign. Their particular worry centers on plans to build highway bridges that will provide 45 ft of vertical clearance over the Upper Mississippi (at LeClaire, Iowa, and LaCrosse, Wis.), against present vertical clearance requirements of 63 ft above flat pool, or 55 ft above the 2 percent line.

* * *

Final break-up of the Civil Rights log jam that blocked almost all legislative business for nearly two months leaves an enormous amount of **unfinished business before Congress.** It must lead to the conclusion, also, that very little of major significance will be passed in what remains of this session. You can figure that Congress will put through only necessary appropriations measures, and some few other things that seem to be good politics. Everything else (and there are now more than 15,000 bills somewhere in the legislative machinery) will be pigeonholed in the rush to get out of Washington in time for the political conventions in July. And remember that anything not acted upon this time dies, since the Congress that meets next January will be a new one.

* * *

Observers who thought—a couple of years ago—that **toll highway construction** would be killed by the advent of the Interstate Highway Program apparently have another think coming. Maryland's highway chiefs have revealed that they are now studying the possibility of building the long-planned Northeast Expressway (paralleling Route 40) from Baltimore to the Delaware line as a toll highway. Delaware is also looking into the economics of carrying the toll facility to the Delaware Memorial Bridge. Reason: The states figure they can get the money faster on bond financing, then can be repaid later by having the road incorporated into the Interstate System.

* * *

The biggest field for new construction business (outside of government) is obviously the **public utilities.** During the month of March alone, 22 electric utilities told the Securities and Exchange Commission they had plans for $965 million worth of construction during what is left of 1960 and into 1962. In the same period, four gas and pipeline companies reported plans for $257.3 million worth of construction. The biggest single construction program, a four-year $700 million plan, was reported by Commonwealth Edison of Chicago.

* * *

Slush on airport runways has become so serious a problem in aircraft takeoffs that the Federal Aviation Agency will form a special industry-wide committee to solve the problem. Slush is of particular concern to the new jets—the FAA said that, a year ago, a Boeing 707 takeoff was stretched so far by the drag of an inch and a half of runway slush that the plane barely cleared a distant retaining wall. As a result of some tests, Boeing has figured that a half-inch of slush increases takeoff length by as much as 10 percent.

* * *

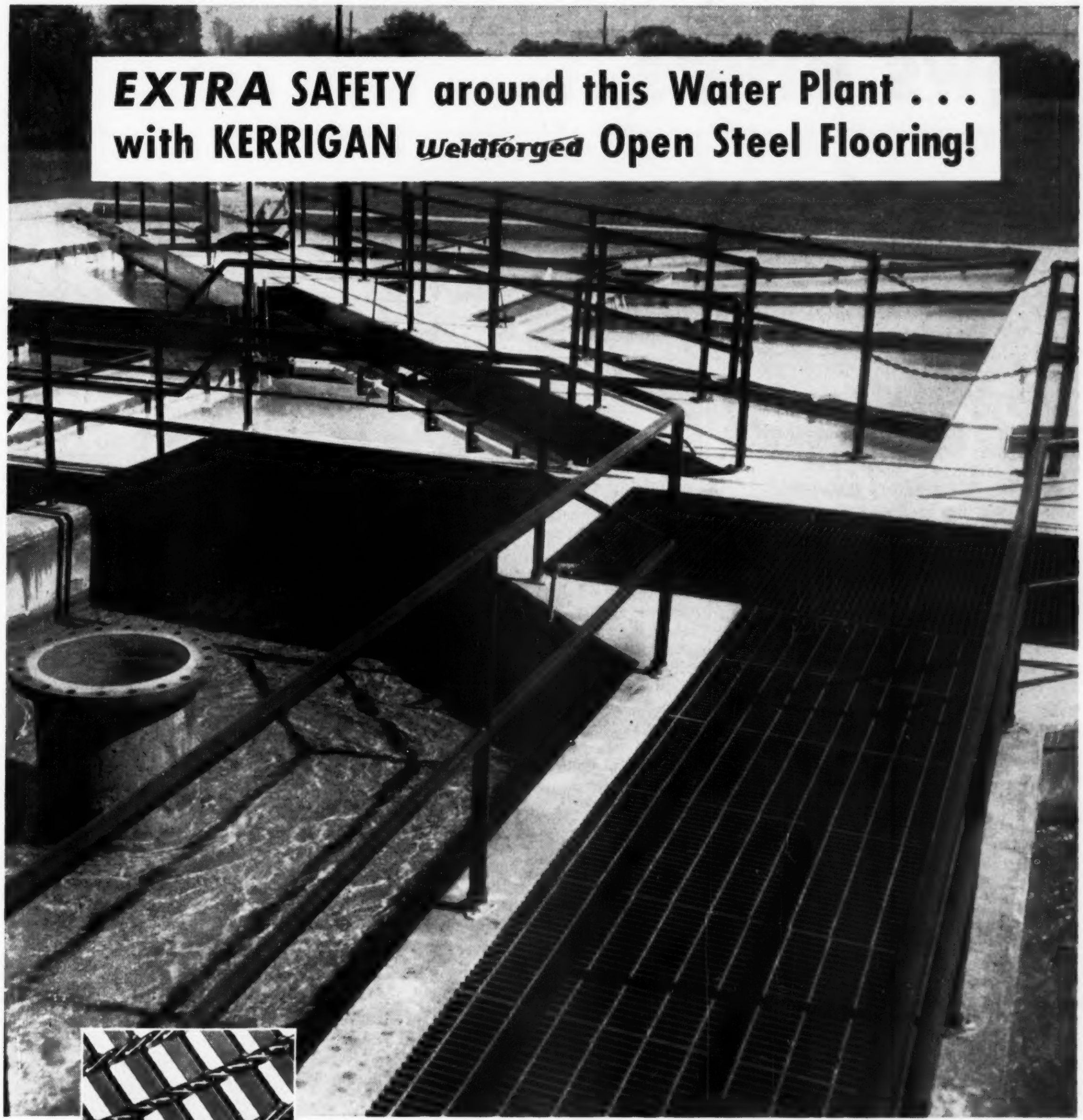
That long-awaited report of the Commerce Department on **"Federal Transportation Policy and Program"** contained only one real surprise: A proposal that toll booths be set up at highway "gateways" to major cities. The idea is that is that tolls would discourage commuters from driving their cars downtown, force them to park and use public transit means. Otherwise, the Commerce report contained the expected recommendations for toll-charges on waterways (via a fuel tax), and encouragement for consolidation of transport means in the interest of efficiency. Waterways interests, incidentally, immediately opposed the report, on grounds that it was aimed specifically at aiding the railroads to the detriment of waterways.

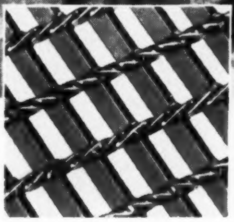
* * *

Congressional leaders are pressuring the states of California, Nevada, and Arizona to get together for talks about a possible new project on the **Lower Basin of the Colorado** to increase hydropower supplies available to the three areas. The spur is an impending head-on collision between the Arizona Power Authority and the City of Los Angeles, both of which have filed competing applications for permission to build a power dam at Bridge Canyon.

* * *

Sanitation specialists and health authorities are looking forward to results of a year-long **pilot study,** scheduled for San Juan County, New Mexico, **on the effects of environmental radiation.** The county is a principal producer of uranium. The study will be conducted by the U.S. Public Health Service, in cooperation with the New Mexico Department of Health.





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News Briefs . . .

AGC Holds Annual Convention in San Francisco

The need for "responsibility and discipline on a national scale" was stressed at the opening session of the Associated General Contractors' 41st annual convention held in San Francisco, March 21-24. In the featured talk Maurice H. Stans, chief of the Bureau of the Budget, warned the leaders of the construction industry that Americans must stop living on "government credit cards" and fight an economic war as they would a military war if the Soviet challenge is to be met with proof that our system is the best. Mr. Stans commented that, "the federal budget is now saddled with yesterday's priorities to such an extent that it has little flexibility with which to meet tomorrow's." He compared the national budget to the planning, designing and carrying out of a construction project, calling the fiscal 1961 budget now before Congress "a design for our time for our nation."

In another session the contractors, assembled from all over the country, were told that both government and private contractors must preserve basic traditions in military construction and, at the same time, be responsive to the challenge of the space age. The speaker was Eugene J. Peltier, M. ASCE, chief of the Navy's Bureau of Yards and Docks. Said Admiral Peltier, "Some people think it is impossible to be responsive to modern construction needs and still preserve our contract traditions, but I believe that a tradition as soundly developed as the plan-design specify-construct concept, combined with advertised competitive bidding, can be preserved through planning, close coordination, and cooperation."

William P. Scott, Jr., president of the Mechanical Contractors Association of America, told the group that construction by the contract method is the one great common product that both management and labor in the construction industry have to sell. He contrasted the method with "do-it-yourself" construction, "including that performed by big industrial plants with their inexperienced production workers."

In another session John N. Richards, president of the American Institute of Architects, remarked that urban redevelopment and the need for large building complexes have drastically changed the face of modern architecture. Emphasizing the vital importance of cooperation between architects and contractors in this era, he said, "Much of the economic future of our country depends largely on how well contractors and architects do their jobs—and how well they work together."

The need for the cooperation of all groups involved in the increasingly complex business of modern construction was the theme of other talks. Jean L. Vincenz, F. ASCE, president of the American Public Works Association, saw cooperation among all persons and organizations concerned with public works problems as essential to saving tax dollars and best serving the public interest.

In summing up AGC accomplishments in the past year, retiring President James W. Cawdrey said, "We have strengthened our relations with architects, are making a real breakthrough in our relations with subcontractors, have improved our labor relations, and opened a broad new avenue in cooperation with labor toward protecting and expanding the market for contract construction which rightfully belongs to the employers and workmen of this industry."

Mr. Cawdrey hailed the formation last spring of the Construction Industry Joint Conference as a cooperative project of the utmost importance. "It marked the first time in history," he told the contractors, "that representatives of every phase of contracting employers in this industry . . . met to discuss problems of mutual interest, and then met with officials of the building trades unions to consider problems and objectives common to the entire industry."

John A. Volpe, Malden, Mass., incoming president of AGC and a prominent contractor, spoke on the multi-billion-dollar interstate highway program. Mr. Volpe characterized as "premature and unconscionable" recent reports of evidence of graft and excessive profits in the highway program. "I favor honest effort to find out the facts in connection with the progress of the highway program or any other government program," Mr. Volpe said. "What I am objecting to is the unjustified con-

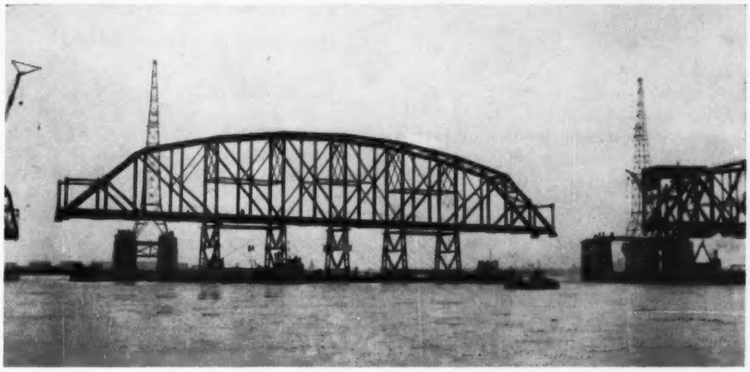
Raising Steel for Second Deck of George Washington Bridge

On March 29 the first structural steel section for the over-river portion of the six-lane lower deck of the George Washington Bridge was raised 200 ft from a barge anchored in the Hudson River adjacent to the New Jersey tower. The 220-ton steel deck assembly was the first of 57 main-span sections that will be put in place from barges anchored in the river. The huge sections—108 ft wide, 90 ft long, and 30 ft deep—are being lifted by four powerful erection trolleys. The Bethlehem Steel Co. is building the second deck for the Port of New York Authority without interfering with bridge traffic.

demnation of engineers, highway officials, and contractors before a single witness is called to testify before Congress. . . . Highways won't be built in hearing rooms and they won't be developed by demagoguery. They will be built by the honest toil of workmen, engineers, contractors and public servants. The important objective is to get on with the job—clear the way for adequate financing and get out and build highways so that the program is completed." Mr. Volpe reminded the group that "highway construction costs today are at their lowest in three years, despite the continual rise in the prices of materials and labor."

At the conclusion of the four-day program Mr. Volpe was installed as president of the AGC for the coming year. M. Clare Miller, head of the San Ore Construction Company, McPherson, Kans., took office as vice president.

The convention was attended by 2,300 leaders of the construction industry.



Tides Help Replace Lift Span on Delaware Bridge

Floating a new lift span into position in the Delair Railroad Bridge over the Delaware at Philadelphia was the single largest and heaviest job of its kind ever undertaken by the American Bridge Division of the U. S. Steel Corporation. Erected on four barges, the 542-ft-long span was maneuvered into its permanent position at high tide and landed on its piers at low tide on March 19. It weighed 2,680 tons. That evening freight trains rolled across the span. The American Bridge Division holds an $8,000,000 contract for construction of the new lift span and the renovation of the remainder of the 65-year-old railroad bridge. The project is part of the Delaware River deepening and straightening program currently underway by the U. S. Corps of Engineers.

Bridge Proposed for English Channel Crossing

As a possible alternative to the long-discussed English Channel Tunnel, an international group of prominent construction companies—British, French, and United States—has offered to build a Channel bridge between South Foreland, near Dover, and Sangatte, near Calais. Plans for the structure have been deposited with the Channel Tunnel Study Group.

The 21-mile-long bridge would cross the Channel in 740-ft spans, with the exception of two spans, 1,500 ft long, and would be 200 ft high to permit passage of the tallest ships. It would provide a five-lane roadway for motor traffic, two railroad tracks, and two 13-ft lanes for bicycles and motorcycles. The plans call for 142 elliptical piers, consisting of heavy precast rings of reinforced concrete superimposed on each other. The steel superstructure would carry the tubular steel spans. The proposed bridge would cost about $560,000,000 and take five years to build.

The three construction companies cooperating in the bridge plans are Dorman Long, Ltd., of England; the Merritt-Chapman & Scott Corporation, of the United States; and Compagnie Francaise d'Entreprises, of France. Merritt-Chapman & Scott would build the foundations, while the British and French companies would construct the bridge itself.

In the meantime, a second international group has submitted proposals for a channel tunnel to cost between $201,000,000 and $268,000,000, depending on its width. Motor traffic through the tunnel would be carried on specially designed trains. American interests in the proposed tunnel are represented by Hyperion Constructors and Kaiser Engineers and Constructors.

Concrete Practices Reviewed at ACI Convention

A wide range of developments in the concrete field was covered at the 56th annual convention of the American Concrete Institute, held in New York City, March 14-17. The development of concrete consolidation methods, from hand tamping to mechanical vibration, was reviewed in a report compiled by ACI Committee 609 and presented by Committee Chairman Joseph J. Waddell. The savings in cost and improvements in concrete quality attributed to vibration were said to make it "one of the greatest advancements in concrete technology." For most structural concrete, vibration is most efficiently performed by means of standard immersion vibrators.

Another popular session dealt with the restoration of deteriorated concrete. The symposium—sponsored by ACI Committee 201 under the chairmanship of Hubert Woods—included a paper on the Prepakt method of repair. How the California Division of Highways uses adhesives and binders containing epoxy resins to repair concrete was outlined by Bailey Tremper, F. ASCE, supervising materials and research engineer for the Division. Only epoxy resins of low viscosity can be used as concrete repair materials. It has been demonstrated in many tests, Mr. Tremper reported, that the bond strength of properly formulated adhesives is greater than that of concrete. Epoxy concrete is considered economical for use in fairly large volume on heavily traveled structures such as the San Francisco-Oakland Bay Bridge. However, if substantial repairs are required and if traffic conditions permit, it was found more economical to use portland cement concrete bound to the original work with a coating of epoxy adhesive.

Another report presented the results of model tests on bridges and dams, including such important structures as Oroville and Glen Canyon dams. A report on air-entrained concrete practices highlighted a session on highways. Although air entrainment has definitely proved its value in producing frost- and salt-resistant concrete, there are some problems that have not been satisfactorily solved. Mix design and field control, it was said, still present serious difficulties because the optimum air content lies within a relatively narrow range and the amount of air introduced into the mix depends upon many different factors. Other well attended sessions were devoted to materials and to design and structural research.

JOE W. KELLY

The new ACI president is Joe W. Kelly, F. ASCE, professor of civil engineering at the University of California. He succeeds Phil M. Ferguson, F. ASCE, professor of civil engineering at the Univer-

sity of Texas. Raymond C. Reese, F. ASCE, consulting engineer of Toledo, Ohio, was elected vice president for a two-year term.

Charles H. Scholer, F. ASCE, was made an honorary member of the ACI. He is a consultant and former head of the department of applied mechanics at Kansas State College. Long active in ACI affairs, he was president in 1954.

Several ASCE members received Institute awards. The Turner Medal went to Harrison F. Gonnerman, of Oak Park, Ill., who was cited for "numerous and outstanding contributions to concrete technology through research and administration." Arthur R. Lord, of Palos Park, Ill., received the Lindau Plaque "for having originated reinforced concrete building tests and for having pioneered in the development of flat-slab construction." Two University of California faculty members, Boris Bresler and K. S. Pister, collaborated to win the Wason Medal for Research.

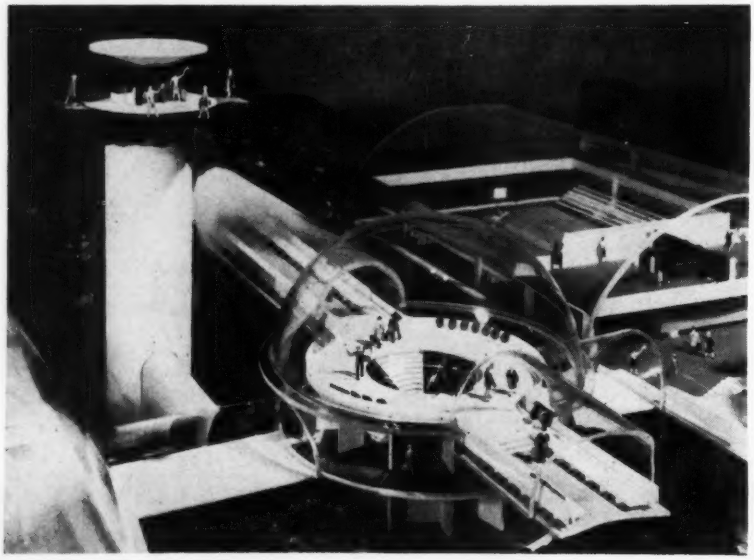
TVA Issues Report on Johnsonville Steam Plant

Publication of Technical Report No. 31, *The Johnsonville Steam Plant,* is announced by the Tennessee Valley Authority. Johnsonville, on Kentucky Lake in western Tennessee, is the first of seven large steam-electric generating plants constructed by the TVA in the 1949-1959 decade. The report details the planning, design, construction, initial operation, and costs of the first six units, and gives statistical data on four additional, and final, units. The report points up the tremendous advances in steam-plant technology in the past decade. The single volume contains 678 pages, including 264 illustrations and 90 exhibits.

The Johnsonville Steam Plant may be purchased from the Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn., for $5. Other similar reports of TVA projects are available also.

Design for Survival—in the Nuclear Age

On the theory that the modern city should be safe from nuclear attack, the Cornell University College of Architecture has revealed models and plans for the protection of an industrial city of 9,000 with one major industry. An entry valve to the underground part of the proposed city is at the left in this model. The lower disc at the top of the tubular entrance represents the ground level in the cutaway model. In case of warning of atomic attack, the upper disc would move downward, sealing the entrance after residents were safely underground. The entry tube (there would be a number of them placed strategically about the city) contains an elevator and circular stairway. The plastic bulb, to the right of the entry point, shows how people would have easy access to the continuous seatway conveyance system at various points. All construction would be of reinforced concrete vaults and domes. The tunnels for the seatway system also contain the conduits for power lines, water supply, sanitation, and air conditioning. The year-long Cornell study of design for survival was financed by the Ford Foundation, the New York State Civil Defense Commission and several industries.



Contract for Staten Island Tower of Narrows Bridge

The Bethlehem Steel Company has been awarded the contract to fabricate and erect the Staten Island Tower of the new $320,000,000 Narrows Bridge linking Brooklyn and Staten Island in New York City. The giant tower, one of two for the twelve-lane suspension bridge to be built for the Triborough Bridge and Tunnel Authority, will contain 27,000 tons of steel. The 630-ft-high steel tower will be fabricated at Bethlehem Steel's Pottstown, Pa., works. Of cellular construction, the tower will be made up of 68 compartments, each 3½ ft square and running the height of the tower. About 800,000 high-strength bolts will be required to make all field connections. A similar tower on the Brooklyn side of The Narrows will be erected by the Harris Structural Steel Co., Inc., after fabrication at their New Market, N. J., yard.

The total length of the Narrows Bridge, with its approaches, will be 13,700 ft. The 4,260-ft suspension span will be 60 ft longer than the span of the Golden Gate Bridge and the longest in the world. The new bridge will link the parkways and expressways of Long Island, Westchester, and New England with the New Jersey arterial system, and will help relieve traffic congestion in midtown Manhattan. It will be opened to traffic in 1965. Ammann & Whitney are the engineers.

Edison Company to Have New Long Beach Office

County and municipal officials and civic leaders joined Southern California Edison executives recently in ceremonies marking the start of construction on the company's new $4,800,000 Long Beach office building. The ten-story building will feature ultramodern design throughout. It will have high-intensity lighting, complete climate control through the use of a modern electric heat pump system, and a multi-level parking facility for tenants. New facilities will include an advanced-design all-transistor computing system for processing the bills and accounts for a million customers.

The contract for construction of the building has been awarded to the Myers Brothers Construction Company, Inc. Completion is scheduled for mid-1961.

Burns & Roe Subsidiary

Burns and Roe, Inc., New York City architect-engineering firm, has established a wholly-owned subsidiary, Burns and Roe Western Hemisphere Corporation. Incorporated under the laws of the State of Delaware, the new corporation will undertake engineering and construction projects in North, Central and South America as well as the West Indies. Projects in the continental United States will continue to be handled by the parent company.

New Magazine for Civil Engineers in Air Force

A new quarterly magazine for the Air Force's Civil Engineers has appeared. The 32-page offset-printed publication, called *Air Force Civil Engineer,* is designed to fill a gap in the dissemination of semi-technical professional material, and will be made up primarily of articles submitted by civil engineers in the field. Methods developed by various bases and commands to do the numerous civil engineering jobs will be highlighted in the hope of disseminating good ideas for future work.

World Increases Its Outlays for Steel

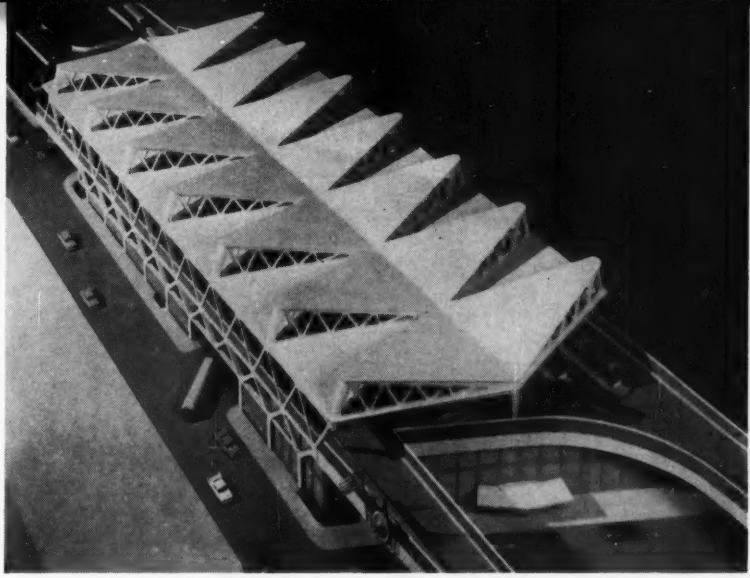
This year countries all over the world will spend a combined \$4.5 to \$5 billion for expansion and modernization of their iron and steel industries, according to the American Iron and Steel Institute. The estimate comes from a study of various published reports and is believed to be on the conservative side.

Approximately \$1.6 billion, or about one-third of the world outlay, is scheduled to be spent by companies in the United States, the largest steel-producing nation. The proportion is slightly higher than this country's share of world steel output, which was around 29 percent last year. Russia, the second largest steelmaking nation, with about 20 percent of the world's output, probably will spend at least \$1 billion for iron and steel facilities this year. Approximately \$1.1 billion will be spent by a group of eight countries which produced about one-third of the world's steel last year. These are the European Coal and Steel Community countries, plus the United Kingdom and Japan. Nearly one-half the \$1.1 billion will be spent in Japan. Large expenditures will also be made in the Communist satellite countries, and in South America, India, Canada, and Mexico.

According to a report from the Economic Commission for Europe, Africa's steelmaking capacity will increase more than 80 percent in the next five years; the capacity in the Middle East will go up about 260 percent; and the potential in the Far East will increase about 140 percent.

New President for AED

Herbert J. Mayer, of San Francisco, Calif., has been named president of the Associated Equipment Distributors. Mr. Mayer, executive vice president of the Western Machinery Co. and general manager of the Edward R. Bacon Co., both of San Francisco, moves up from the post of senior vice president. He succeeds Jewell A. Benson, who died on February 19 shortly after his induction as the association's 41st resident.



Unique Roof for Bridge Bus Station

Model of the \$13,000,000 George Washington Bridge Bus Station, which is being built by the Port of New York Authority as part of the second-deck project, highlights the striking roof design developed by Dr. Pier Luigi Nervi, noted Italian architect-engineer. The two-block, three-level bus station, to be completed in the summer of 1962, will straddle the twelve-lane George Washington Bridge Expressway between Fort Washington and Wadsworth Avenues. The unusual roof design features 26 triangular sections, 14 of which slope upward from a row of columns in the center of the building. The vertical sides of the raised roof sections will be glass enclosed and louvered for better ventilation of the bus-loading platforms. The project will be New York's first example of the distinguished Italian designer's work.

Construction Spending in March Below 1959 Level

The value of new construction put in place this March amounted to \$3.7 billion, according to preliminary estimates of the Bureau of the Census of the U. S. Department of Commerce. This was 5 percent above the February 1960 level, but 4 percent below the March 1959 value. Seasonal expectations call for an increase of about 8 percent between February and March. The cumulative value of construction expenditures in the first three months of 1960 was \$10.9 billion, 2 percent below the comparable 1959 total.

New private construction expenditures in March 1960 amounted to \$2.7 billion, 4 percent more than in February 1960 and about the same level as in March 1959. The February-to-March increase in private construction was also less than the expected seasonal rise for the period. Consequently, the seasonally adjusted annual rate of private construction declined in March by 3 percent, with private residential building the major factor in this decrease. Spending for private residential construction in March 1960 amounted to \$1.4 billion. This was 6 percent more than in February, compared to a normal seasonal increase of about 10 percent between February and March. Private nonresidential building expenditures declined by 2 percent in March of this year to \$0.75 billion, compared to an expected seasonal rise of about 1 percent from February to March.

The cumulative value of private construction expenditures in the first three months of 1960 was \$8.0 billion, 3 percent above the total for the comparable period of 1959. The cumulative value of expenditures for residential building in the first three months of 1960 showed an over-the-year decline of 3 percent to \$4.3 billion. However, increases in expenditures for all other types of private construction more than offset this decline in residential expenditures.

Public construction expenditures this March amounted to \$1.0 billion, eight percent more than in February, but 14 percent below the March 1959 level. The February-to-March change was less than the normal seasonal increase for that period. Highway expenditures in March showed a normal seasonal rise and remained at an annual rate of approximately \$5.8 billion. Expenditures for nearly all other types of public construction increased in March but by less than the normal seasonal February-to-March change.

In the first three months of 1960, cumulative expenditures for public construction were 14 percent less than in the same period in 1959. The major types of public construction—highways and educational buildings—shared in this over-the-year decline.

Breezy Point—Site for a New City?

The 3½-mile-long Breezy Point Peninsula in Queens County, New York, is the site for the world's largest privately financed community. The tract was purchased for $17,500,000 cash, a record price for a single-unit tract of land in New York City. In announcing the purchase, Northern Properties, Inc. described Breezy Point as the projected site of a new middle-income community for approximately 220,000 persons. At an estimated cost of $1¼ billion, the new community will include modern apartment houses, 21 private and public schools, 12 parks, museums, churches, shopping centers, marinas, and the other services needed by the expected 60,000 families. A detailed master plan is now being developed and ground breaking for the first section of the community is expected to take place in the summer of 1961. Brodsky, Hopf and Adler are the Architect-Engineer for the project.

Building Research Meeting Features Design for Cheaper Maintenance

Meeting in New York in April, the Building Research Institute of the National Academy of Sciences held three days of conferences on newest developments in the design, construction, operation and maintenance of buildings. Howard E. Phillips, building engineer for the American Telephone and Telegraph Company, New York, gave some interesting figures on the cost of maintenance of specific types of buildings. New construction for the Bell System in 1959 cost $178 million; maintenance $31 million; and house service $93 million. About 27 percent of maintenance expense went for painting, indicating the reason for substantial interest at this session in wall coatings. Plumbing accounted for 14 percent, and waterproofing of exterior walls and below ground 10 percent. Elevators, electrical installations, heating, air conditioning, ventilation and floor covering, each took from 6 to 7 percent of the maintenance money.

Mr. Phillips pointed out that there are many reasons why performance in service information does not get back to the place where it can do some good for another structure. The material producer wants the world to know about the good points of his product; the architect does not want it thought that his choice of products and techniques can stand improvement; the builder wants no possible reflection on the excellence of his work; and the owner does not want anything published indicating that his building has faults. A demand from the owner for too low a cost on the initial building or quick completion is likely to result in higher maintenance and repair costs, over all its years of service.

Adhesives came in for very substantial attention at the BRI meeting. R. K. Hoelmke, marketing supervisor for the Minnesota Mining and Manufacturing Company, told about new items in the building field. Adhesives have allowed the fabrication of extremely strong, lightweight curtain wall sandwich panels. They are being used in the assembly of scaffolding to obtain lighter-weight units of more uniformly high strength and at lower cost than was possible with welding. Corner joints of window and door frames, designed to put the adhesive in shear, are quite successful.

Due to outstanding success in the restoration and maintenance of, and additions to, existing structures, bonding agents such as epoxy resins are being investigated and experimented with for new design, said John W. Davis, partner in Lacy, Atherton and Davis. At West Point twenty years ago anchors for a brick veneer were fastened to a retaining wall by an adhesive. As a result of the evident success of this application, engineers for the Hydro-Electric Power Commission of Ontario tested adhesive-glazed brick veneer combination to an existing red clay brick wall. A forcible effort on a large panel of the veneer failed to weaken or fracture the adhesive bond or the existing brick.

Raymond J. Schutz, of the Sika Chemical Corporation, told about bonding agents for cementitious materials. The base material may be a straight epoxy resin or an epoxy thiokol blend. The curing agents are usually amines. Experience has shown that it is best to package the material so that full units are mixed rather than having measuring done on the job. Surface laitance must be removed by sand-blasting, acid washing, or chipping if bond strengths in excess of 75 to 100 psi are desired. Mill scale should be removed from steel. The adhesive should be spread by brush as any dust that might be left on the surface is combined into the adhesive as a filler instead of acting as a bond breaker.

Speaking on origin and removal of air contaminants, Louis C. McCabe, of Resources Research, Inc., pointed out that sootfall in Manhattan in January and February 1956 averaged 103 tons per sq mile per month. Dustfall in Perth Amboy in 1955 averaged 200 tons per sq mile per month. Unburned fuel from coal, oil, and gasoline adds greatly to the pollution of the atmosphere along with odors from sewage disposal, food processing and chemical plants. Mr. McCabe commented favorably on activated carbon installations to purify air drawn into buildings by ventilation systems.

How to design and build cavity walls was covered fully in an all-day session. These walls offer advantages, but require careful design and placement for best thermal economy and freedom from cracks.

The Building Research Institute appropriated $2,000 to establish a Building Science Education Fund to stimulate building research activities in colleges and universities. It is hoped that contributions to this fund for research will be made. Inquiries may be through the Building Research Institute, National Academy of Sciences, 2101 Constitution Ave., Washington 25, D. C.

New Road for Ecuador

Engineering for a proposed 350-mile highway program in the Republic of Ecuador is being done for the Ecuadorean government by Rader and Associates, of Miami, Fla. The proposed program will include some 85 miles of roads on the eastern slopes of the Andes, leading through largely unexplored territory to the headwaters of the Amazon River and providing access to Brazil for Ecuadorean crops. The program is expected to cost around $14,000,000.

The proposed new program is separate from a previous $30,000,000 highway system in Ecuador, including a portion of the Pan American Highway, for which Rader and Associates are the engineers. The latter project is now more than half completed.

Off for Morocco—to Study Earthquake Damage

Four experts on design requirements for earthquake-proof structures leave International Airport for Agadir, Morocco, to make a study of structures damaged in the recent earthquake that took 10,000 lives. The mission is being sponsored by the American Iron and Steel Institute on behalf of the U.S. steel industry. Pictured, left to right, are R. W. Binder, F. ASCE, chief engineer, Bethlehem Steel Co., Pacific Coast Division; T. R. Higgins, F. ASCE, director of engineering and research for the American Institute of Steel Construction; Prof. Ray Clough, M. ASCE, of the University of California; and W. G. Kirkland, F. ASCE, chief of the engineering division of the American Iron and Steel Institute. Findings of the four-man team will be made available to the Moroccan government.

EXAM GEMS

by Reggie Strashn

R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 10 asked first for reactions and second for deflections due to a single concentrated load on a pinwheel frame. To the neophyte, there are 8 unknowns—4 column reactions and 4 beam interactions, so he may start by trying to write 8 simultaneous equations. There is an easier way: start with one unknown and work around the pinwheel computing each reaction in terms of it until you come back to it and have just one equation in one unknown. If you start at the right place, you have an easy exercise in mental arithmetic, but if you start at the wrong place you just get the exercise.

Observe, first, (Fig. 1*a*), that each of the 4 beams is simply supported with a single concentrated load at the center. This load must be twice the equal end reactions. Designating the latter by the column symbol and starting with the reaction C at Column C, we can write or think:

$F = 2C$
$E = 2F = 4C$
$H = 2E = 8C$
$60 + G = 2H = 16C = 60 + C$
$15C = 60$
$C = 4; B = 8; \quad A = 16; D = 32$

Next observe the typical deflection curve for each girder (Fig. 1*b*). The total deflection of the midpoint is the sum of the flexural deflection kP proportional to the load, plus half the total deflection of the far end. Designating these total deflections at E, F, G and H by e, f, g and h, a typical relation is $g = kP + \frac{1}{2}h$. But

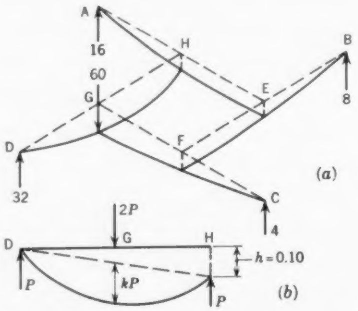


Fig. 1. Deflection of a pinwheel frame, (a) isometric of four mid-joined girders supported by Columns A, B, C, and D; (b) geometry of deflected girder DH.

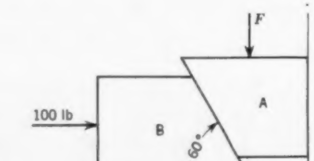


Fig. 2. The problem of the weightless wedges.

h is given and this $P = 32$, so......

$h = 0.10$
$g = 32k + 0.05$
$f = 4k + 16k + 0.025$
$e = 8k + 10k + 0.0125$
$h = 16k + 9k + 0.00625 = 0.10$
$25k = 0.09375$
$4k = 0.015$
$e = 0.08; f = 0.10; g = 0.17$

The gem quality in the problem was the reward for the man who could start at the right place. The simplest method is best because it reduces the chance of mistake.

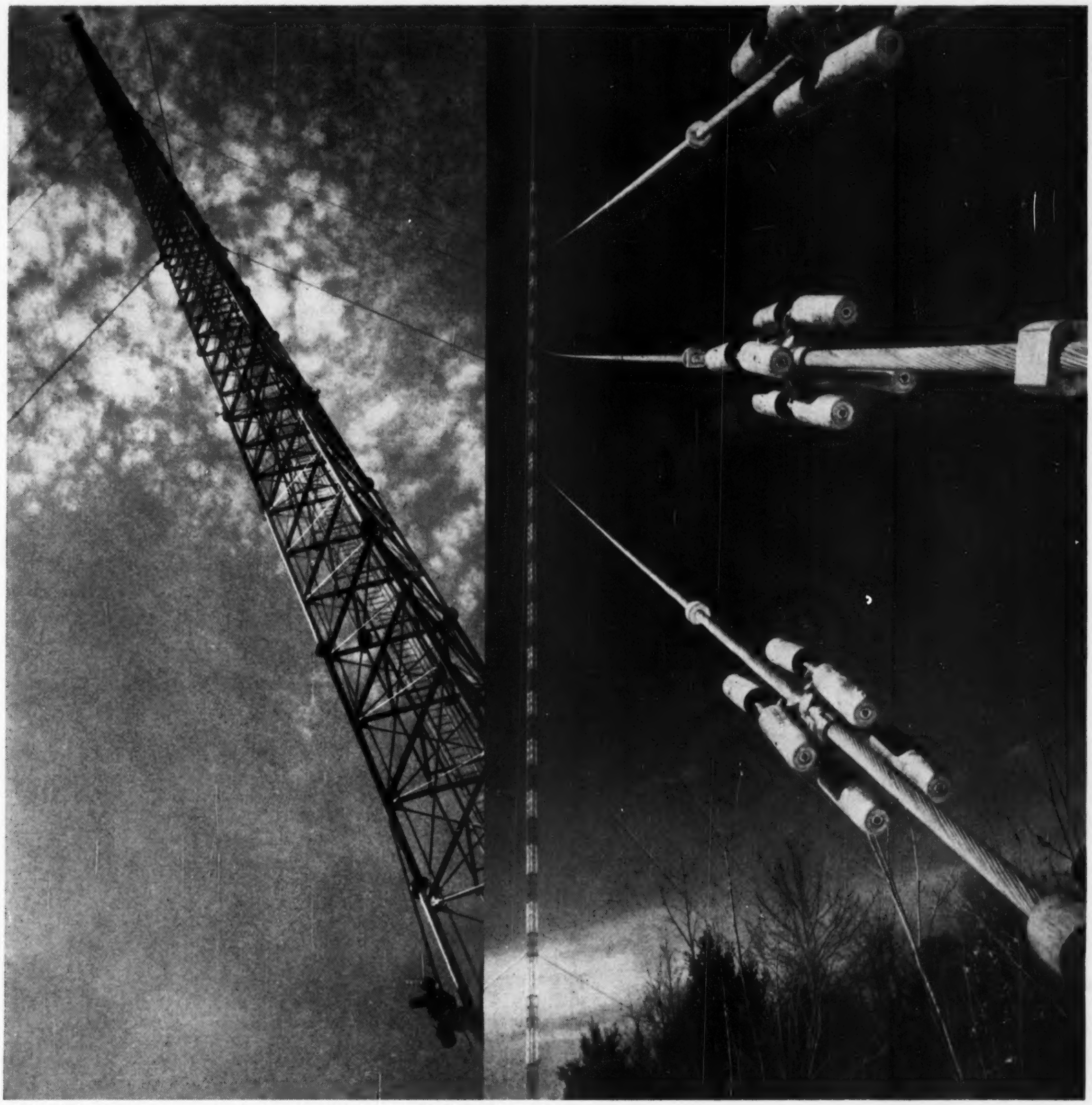
There was a less precious gem in the redundant information that the girders were 24WF76. Some tried to use it by assuming E=30,000,000 psi and deriving k. When this gave a different value for h than 0.10, some said the given value was wrong, while others adjusted E to agree, then derived substantially the correct deflections for e, f and g. This is eloquently called the hard way.

There have been many versions of the problem, some being easier and some harder, but most of them will yield to a rotational attack using just one unknown. Try one with 3 beams, or with distributed loads, or with connections at third points.

EXAMGEM No. 11

It is axiomatic that the more you learn about friction, the more you can forget about friction, especially in the tense environment of the examination room. Like in Alaska 6 years ago when this was assigned:

In the wedge system shown (Fig. 2), the coefficient of friction, f, on all sliding surfaces is 0.25. Determine the force F required to move wedge A downward. Neglect weights of wedges.



WGAN-TV transmitting tower, Portland, Maine. Held aloft by Roebling bridge strand.

18 "Good Guys" From Roebling Hold World's Tallest Man-Made Structure Proudly Erect

This is just about as high as you can go without a launching pad. This KIMCO tower was designed, fabricated and built by Kline Iron & Steel Company, Columbia, South Carolina, for WGAN-TV, Portland, Maine. It reaches 1619 feet into space. Man has yet to go higher and still be anchored to Mother Earth.

Holding this "air-borne" giant up there are eighteen prestretched galvanized guys, made of Roebling bridge strand at their plant in Trenton, New Jersey. These guys measure some four and a half miles in length. Other breath-taking statistics are: 520,000 lbs. of steel in the tower and the longest vertical lift elevator ever constructed. As for nuts and bolts – there are 13,400 of them.

There's only one place to go when you have a guying problem and that's to Roebling's. Our experience and facilities for solving all types of suspension problems and in meeting the soaring needs of broadcasters everywhere are unlimited. Write Bridge Engineering, John A. Roebling's Sons Division, Trenton 2, N. J.

Strand Dia. (Inches)	Total Length (ft.)	Average Length Each Guy
3 @ 1-1/4	2025	675
3 @ 1-5/16	2370	790
9 @ 1-7/16	13065	3 @ – 970
		3 @ – 1505
		3 @ – 1880
3 @ 1-9/16	5040	1680

Designed, fabricated and erected by Kline Iron & Steel Co., Columbia, South Carolina.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

DECEASED

Birger Arneberg (A.M. '24; M. '59), age 67, for many years with the Tennessee Valley Authority engaged on the design of dams and related work, died recently in Oslo, Norway. Mr. Arneberg returned to his native Norway when he resigned from TVA a few years ago.

Edmond Leo Belladonna (M. '50; F. '59), age 51, for the past 22 years an engineer with the Army Corps of Engineers, died in Atlanta, Ga., on March 27. As hydraulic engineer in the Corps' South Atlantic Division office for the past eight years his principal duties consisted of coordinating and reviewing the hydraulic design for civil works projects, and coordinating the Electronic Data Processing Systems program. Before joining the Corps in 1938, Mr. Belladonna held various positions with the Bureau of Public Roads and the National Park Service.

John N. Bosshart (A.M. '59), age 27, a 1959 graduate of South Dakota State College, died recently in Winnebago, Minn. After graduating from college Mr. Bosshart joined the Iowa Highway Commission in Creston, Iowa, as an engineer-in-training.

Robert L. Cashen (A.M. '33; M. '59), age 56, administrative vice-president of the H. K. Ferguson Company, Cleveland, Ohio, died there on April 6. Mr. Cashen joined the firm in 1946 as assistant to the general manager, was promoted to vice-president in charge of operations in 1950, vice-president and manager of the Eastern District in 1955, and vice-president in charge of administration in the main office in Cleveland in 1956.

Sigurd Eliassen (A.M. '22; M. '59), age 75, a consulting engineer with the Norwegian Government Reconstruction Department, died recently in Oslo, Norway. As engineer in charge of the Survey Department of the Yellow River Commission in Honan, China, for 20 years he investigated the floods and heavy silt loads of the Yellow River. He was author of a book on his experiences in China, *Dragon Wang's River,* published two years ago.

William F. Farnham (M. '49; F. '59), age 51, since 1948 associated with the consulting engineering firm of Modjeski and Masters, Harrisburg, Pa., died on March 22, in Ithaca, N. Y. Mr. Farnham recently became a partner in the bridge designing firm after several years as project engineer, and at the time of his death was conferring with Ithaca officials about a proposed bridge project.

A. Prescott Folwell (M. '22; F. '59), age 95, long-time editor of the *Public Works Magazine,* died on March 16, in Vienna, Va. For more than 40 years, Mr. Folwell was editor of the *Public Works Magazine,* remaining on the staff of the magazine as a consultant until about five years ago, when he moved to Vienna from Montclair, N. J. He was a former president of the American Public Works Association.

John Angell Fox (M. '09; F. '59), age 90, of Greenville, Miss., died there recently. Professionally, Mr. Fox was responsible for the promotion of plans for the Greenville Air Force Base and for developing the Port of Greenville, and had been an engineer with the Florida East Coast Canal. He had been special director of the Natural River and Harbors Congress, commissioner general of the Panama California Exposition, and most recently secretary of the Washington County (Miss.) Chamber of Commerce.

Forrest D. Garretson (M. '57; F. '59), age 59, manager of the highway division of the Swindell-Dressler Corporation, Pittsburgh, Pa., died there recently. In 1952 Mr. Garretson, as engineer and general superintendent, represented Michael Baker, Jr., Inc., in Saudi Arabia. Later, at the Saudi Arabian Government's behest he set up a complete engineering organiza-

(Continued on page 114)

Deceased

(Continued from page 112)

tion for the country under the Director of Public Works, acted as engineering adviser to the Minister of Finance, and in addition designed and constructed a reservoir for Riyadh, public buildings throughout the country, and a power plant for Medina.

Charles Goetz (M. '58; F. '59), age 54, civil engineer with the Army Corps of Engineers, Baltimore District, died in Baltimore, Md., on March 3. Mr. Goetz spent several years making field investigations and studies leading to the construction of the Safe Harbor Hydroelectric Development on the Susquehanna River for the Pennsylvania Water and Power Company. In 1955 he joined the Corps of Engineers and had been engaged in writing reports on the proposed Susquehanna Flood control project.

Samuel T. Goldsmith (A.M. '26; M. '59), age 70, who retired five years ago as a civil engineer, died in Lake Wales, Fla., on March 30. At one time Mr. Goldsmith worked for the old New York Board of Transportation, predecessor of the Transit Commission, and for the New York City Housing Authority. He had also served with several construction companies and as an engineer for the State of Florida.

Alexander Haring (M. '06; F. '59), age 88, a retired engineer and professor emeritus in the New York University School of Engineering, died recently in New York City. Mr. Haring retired from teaching in 1936 to resume the consulting practice he gave up to join the New York University faculty. However he taught on a part-time basis at N.Y.U. and Manhattan College during World War II.

Lewis T. Howard (A.M. '08; M. '59), age 85, retired civil engineer of Tappan, N. Y., died there recently. In the 1920's Mr. Howard served as assistant engineer in the New York Department of State Engineering and Surveying. For many years he was on the staff of a New York City engineering firm. Mr. Howard was a graduate of the Massachusetts Institute of Technology.

Lawrence Lee Jemison (M. '31; F. '59), age 73, since 1919 bridge engineer with the State Road Commission of West Virginia, died in Charleston, W. Va., on March 3. During this time he was responsible for the construction and maintenance of hundreds of bridges, including many large spans over the Ohio and Kanawha Rivers. For many years he was active in the committee work of the American Association of State Highway Officials.

Lewis Allen Jones (M. '19, F. '59), age 74, former head of drainage investigations for the U.S. Soil Conservation Service, died on March 24, in Washington, D. C. He began his career with the Department

(Continued on page 117)

Deceased

(Continued from page 114)

of Agriculture in 1909 and after several years absence—from 1917 to 1931—returned as chief of the Drainage Division. When, in 1939, his work was transferred to the Soil Conservation Service, Mr. Jones was made head of the Division of Drainage and Water Control where he remained until his retirement in 1952. One of his outstanding accomplishments was the development of a plan for drainage and water control of the Florida Everglades region.

Charles T. Leeds (M. '13; F. '59), age 82, Major, U.S. Army (retired) and director and vice-president of the Los Angeles firm of Leeds, Hill & Jewett, died at his home in Pasadena, Calif., on March 20. As a partner in Leeds, Hill and Jewett and its predecessor firms since 1912, he had acted as consultant on many notable projects including the Colorado River Aqueduct. An expert in beach erosion studies, he was consulting seacoast engineer for the State of California. At one time he was U.S. district engineer for the Los Angeles District of the Corps of Engineers.

John S. Longwell (M. '29; F. 59), age 72, retired chief engineer and general manager of the East Bay Municipal Utilities District, Oakland, Calif., died recently in Piedmont, Calif. He was an engineer with the U. S. Reclamation Service for 14 years before joining the district as division engineer in 1924. One of his outstanding achievements was the engineering of the $23.5 million East Bay Sewage Disposal System.

Raul Jose Felix Lucchetti (A.M. '27; M. '59), age 63, structural design engineer with the Puerto Rico Water Resources Authority, died recently at Rio Piedras, Puerto Rico. In the engineering employ of the Government of Puerto Rico for many years, he was responsible for the construction of the sewerage system for Humacao, the design of the bulkhead pier for the San Juan Harbor Board, the construction supervision of the Puerto Rico Glass Corporation Building, and the structural design of the Authority's nine-story main office building. He was a graduate of Cornell University.

John L. Mason (M. '41; F. '59), age 62, Commander, Civil Engineer Corps, U.S. Navy, died recently in Oakland, Calif. From 1951 until his retirement from active duty in 1958, he was Corps adviser to the Venezuelan government in Caracas. He was assistant city engineer of Modesto, Calif., from 1938 to 1941, and engineer-manager of the Central Contra Costa Sanitary District from the latter year until 1951. For the past two years he had served in a civilian capacity as head of the industrial and facilities division of the Navy's Bureau of Weapons Representative at Sunnyvale, Calif.

Slava Moshneen (M. '53; F. '59), age 73, former engineer inspector general in the Roumanian Ministry of Public Works and Communications, died in New York City on April 2. Mr. Moshneen served the Ministry in various capacities from 1929 until 1948, when he left Roumania to come to the United States. Since then he had been with the Semet-Solvay Engineering Division of the Allied Chemical and Dye Corporation, with Hardesty & Hanover as a designer, and most recently with the Marberry Corporation as civil engineer and designer.

Francis A. Murray (A.M. '38; M. '59), age 64, for the past 30 years city engineer of Summit, N. J., died there recently. Mr. Murray's professional life had been spent in service to Summit. In 1919 he was named assistant engineer on design and plans for municipal improvements, in 1925 assistant city engineer, and in 1930 city engineer and engineer for the Planning Board.

Frederick C. Schubert (M. '09; F. '59), age 91, retired civil engineer of Portland, Ore., died there recently. From 1900 to 1935 Mr. Schubert was with the U. S. Engineer Department in responsible charge of engineering work in the Portland District. Later he served for several years as senior engineer in the Portland office of the War Department, retiring in 1943.

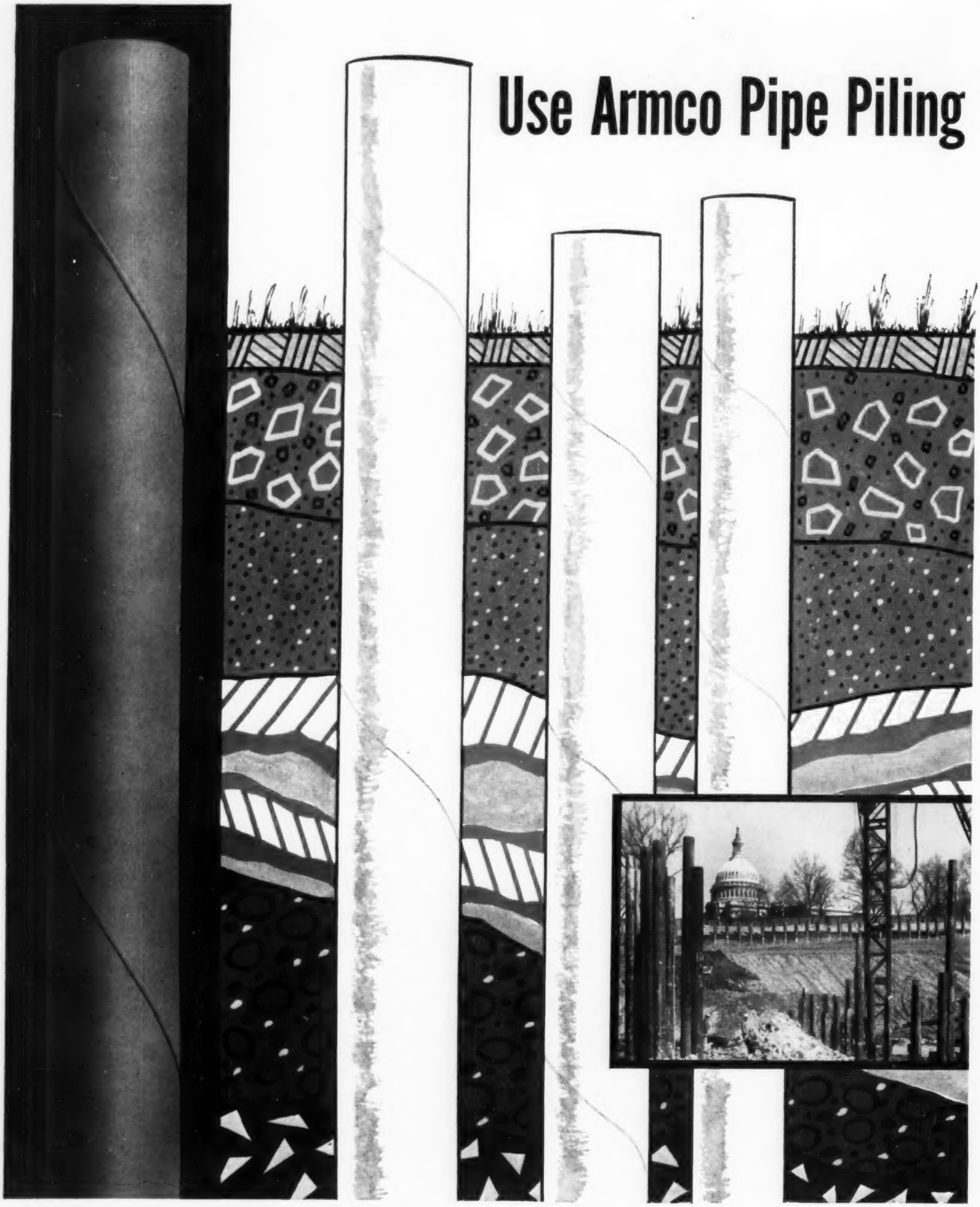
George Peter Searight (A.M. '18; M. '59), age 73, from 1927 to 1941 borough manager of Carlisle, Pa., died there recently. In addition to his duties as borough manager, Mr. Searight acted as engineer, street commissioner, superintendent of the water plant, and in general had full charge of all the borough's administrative and engineering business. During World War II he served as a captain in the Corps of Engineers.

George R. Strandberg (M. '29; F. '59), age 72, who retired in 1958 from the Stone and Webster Engineering Corporation, Boston, after more than 40 years' continuous service in its engineering department, died in Newton, Mass., on March 16. Mr. Strandberg had served the Boston firm as chief hydraulic engineer for many years, and more recently as consulting engineer. He was a former chairman of the ASCE Power Division.

Leonard Church Urquhart (M. '23; F. '59), age 73, since 1949 a member of the Newark, N. J., firm of Porter, Urquhart, McCreary & O'Brien, died on March 3 in Orange, N. J. Mr. Urquhart had been a professor of civil engineering at Cornell University, Drexel Institute and the University of Hawaii, and designer of military construction for the Army Corps of Engineers during both World Wars. He was author of a standard engineering handbook and of a widely used text on "Design of Concrete Structures."

P. H. Wilson, Sr. (M. '09; F. '59), age 85, former director of buildings and grounds at the University of Pennsylvania, died recently in Devon, Pa. Mr. Wilson, retired for many years, supervised the construction of many of the university's famous facilities.

Use Armco Pipe Piling



Non-ASCE Meetings

American Institute of Chemical Engineers. Meeting at the Del Prado Hotel, Mexico City, Mexico, June 19-22. F. J. Van Antwerpen, Secretary, AIChE, 25 West 45th Street, New York 36, N. Y.

American Institute of Electrical Engineers. Summer general meeting in Atlantic City, N. J., June 20-24. AIEE, 29 West 39th Street, New York 18, N. Y.

American Institute of Mining, Metallurgical and Petroleum Engineers. International powder and metallurgy conference at the Biltmore Hotel, New York, N. Y., June 13-15. E. O. Kirkendall, Executive Secretary, AIME, 29 West 39th Street, New York 18, N. Y.

American Society for Engineering Education. Annual convention at Purdue University, Lafayette, Ind., June 20-24. W. Leighton Collins, National Secretary, ASEE, University of Illinois, Urbana, Ill.

American Society of Mechanical Engineers. Applied mechanics conference at Pennsylvania State University, University Park, Pa., June 20-22. A. B. Conlin, Jr., Meetings Manager, ASME, 29 West 39th Street, New York 18, N. Y.

American Society of Photogrammetry. Spring technical meeting of the Ohio Region at the University of Illinois, Urbana, Ill., May 20. Houssana Karara, Pres., or Gordon Gracie, Publicity Committee, Survey Building, University of Illinois, Urbana, Ill.

American Society for Testing Materials. Annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-July 1. Fred F. Van Atta, Assistant Secretary, ASTM, 1916 Race Street, Philadelphia 3, Pa.

California Institute of Technology. Conference sponsored by the Institute's Management Development Center at the California Institute of Technology, Pasadena, Calif., June 19-24. Management Development Center, California Institute of Technology, Pasadena, Calif.

Concrete Reinforcing Steel Institute. Annual meeting at the Greenbrier, White Sulphur Springs, W. Va., May 30-June 4. H. C. Delzell, Managing Director, CRSI, 38 South Dearborn Street, Chicago 3, Ill.

Cooper Union. Conference on civil engineering education co-sponsored by the American Society of Civil Engineers and the American Society for Engineering Education at the University of Michigan, Ann Arbor, Mich., July 6-8. Dr. Felix A. Wallace, Cooper Union, New York 3, N. Y.

Engineering Institute of Canada. Seventy-fourth annual meeting at the Royal Alexandra Hotel, Winnipeg, Manitoba, May 25-27. The General Secretary,

(Continued on page 122)

AMERICAN SOCIETY OF CIVIL ENGINEERS

Reno Convention

June 20-24, 1960

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☐ Holiday	$8–14	$11–17	$12–18
☐ Mapes	$10	$14	$16
☐ Riverside	$9	$14	$14

DATE AND HOUR OF ARRIVAL ....

DATE OF DEPARTURE ....

NAME ....
(Please print)

STREET ....

CITY .... ZONE .... STATE ....

All three "official hotels" are situated within one block of Registration Desk in State Building

Non-ASCE Meetings

(Continued from page 120)

EIC, 2050 Mansfield Street, Montreal 2, Quebec.

Institute of Sewage Purification. Annual conference at Scarborough, England, June 21-24. The Joint Secretaries, ISP, 10 Cromwell Place, South Kensington, London, S.W. 7.

International Association for Bridge and Structural Engineering. Sixth congress in Stockholm, Sweden, June 27-July 1. Secretariat of the IABSE, Swiss Federal Institute of Technology, Zurich, Switzerland.

International Commission on Irrigation and Drainage. Fourth congress at Madrid, Spain, May 30-June 5. El Secretario del Comite Nacional Espanol de la Comision Internacional de Riegos Y Drenajes, Ministerio de Obras Publicas, Agustin de Bethencourt, numero 4, Madrid, Spain.

Israel Institute of Technology. International symposium on concrete and reinforced concrete in hot countries at the Building Research Station of the University, Haifa, Israel, in July. RILEM Symposium, c/o Building Research Station, Israel Institute of Technology, Haifa, Israel.

National Association of Power Engineers. Annual convention at the Jack Tar Hotel, San Francisco, Calif., June 27-30. Edward J. Schuetz, National Secretary, NAPE, 176 West Adams Street, Chicago 3, Ill.

National Society of Professional Engineers. Annual meeting at the Statler Hotel, Boston, Mass., June 8-11. Paul H. Robbins, Executive Secretary, NSPE, 2029 K Street, N.W. Washington 6, D. C.

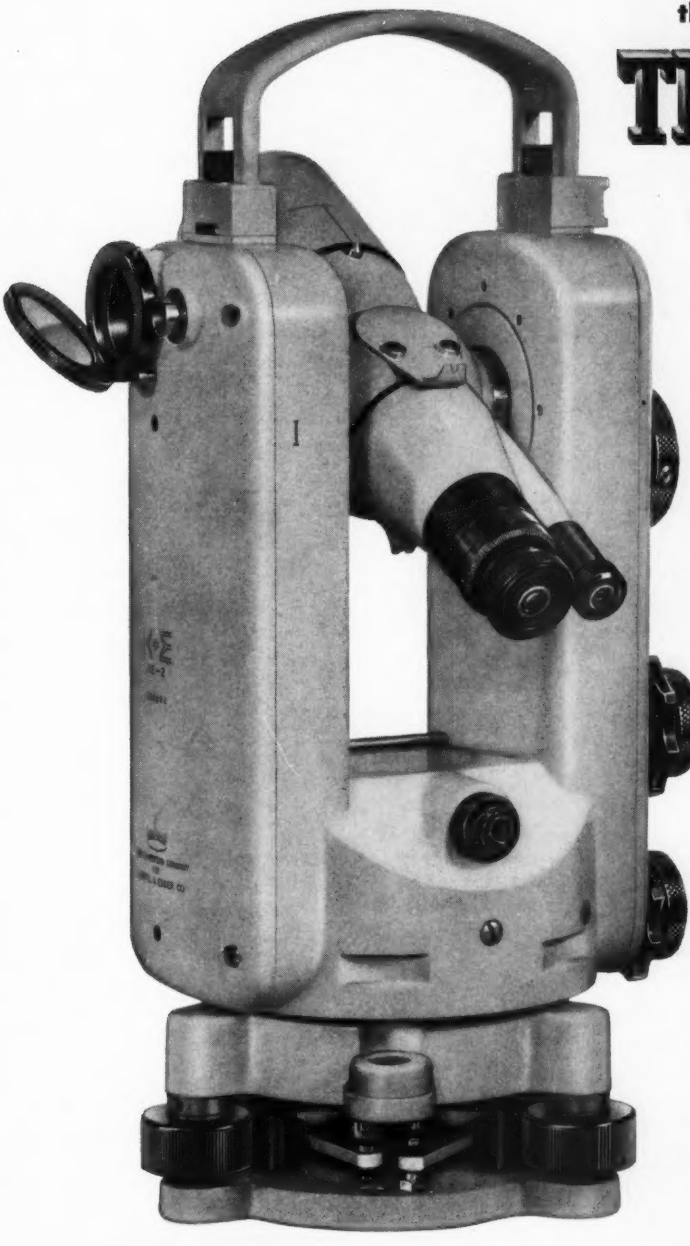
Society of American Military Engineers. National convention in Washington, D. C., May 19-20. F. H. Kohloss, Executive Secretary, SAME, Mills Building, 17th at Pennsylvania Avenue, N.W., Washington 6, D. C.

Society of Automotive Engineers. Summer meeting at the Edgewater Beach Hotel, Chicago, Ill., June 5-10. Robert W. Crory, Manager, SAE, Meetings Operation Department, 485 Lexington Avenue, New York 17, N. Y.

Society of Naval Architects and Marine Engineers. Spring meeting at the Statler Hilton Hotel, Washington, D. C., May 26-28. Society of Naval Architects and Marine Engineers, 74 Trinity Place, New York 6, N. Y.

Society of Women Engineers. Annual convention at the Benjamin Franklin Hotel in Seattle, Wash., June 9-12. J. Adron Troxell, 3613 East 43rd Street, Seattle 5, Washington.

Western Association of State Highway Officials. Meeting at the Multnomah Hotel, Portland, Ore., June 19-24.

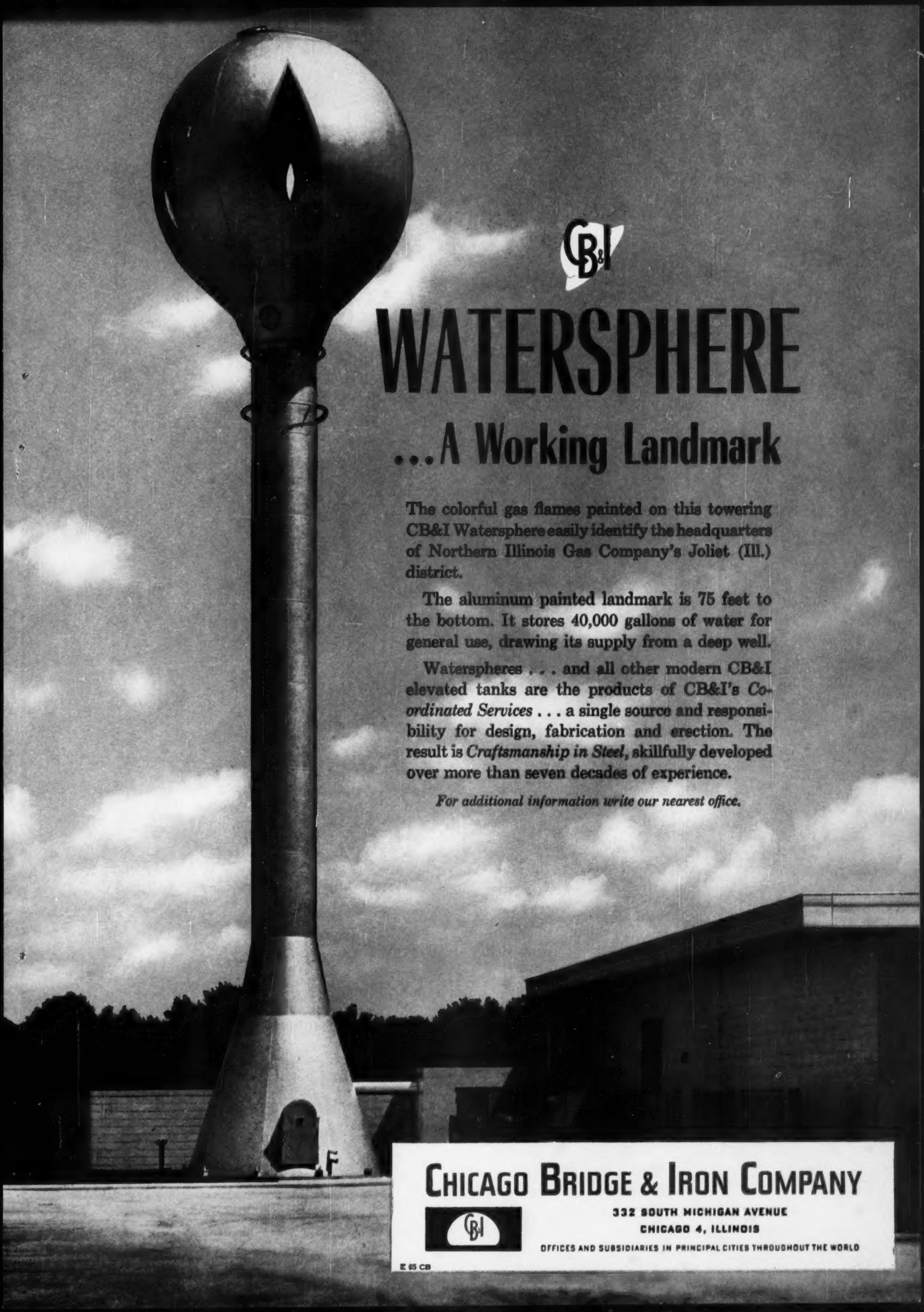


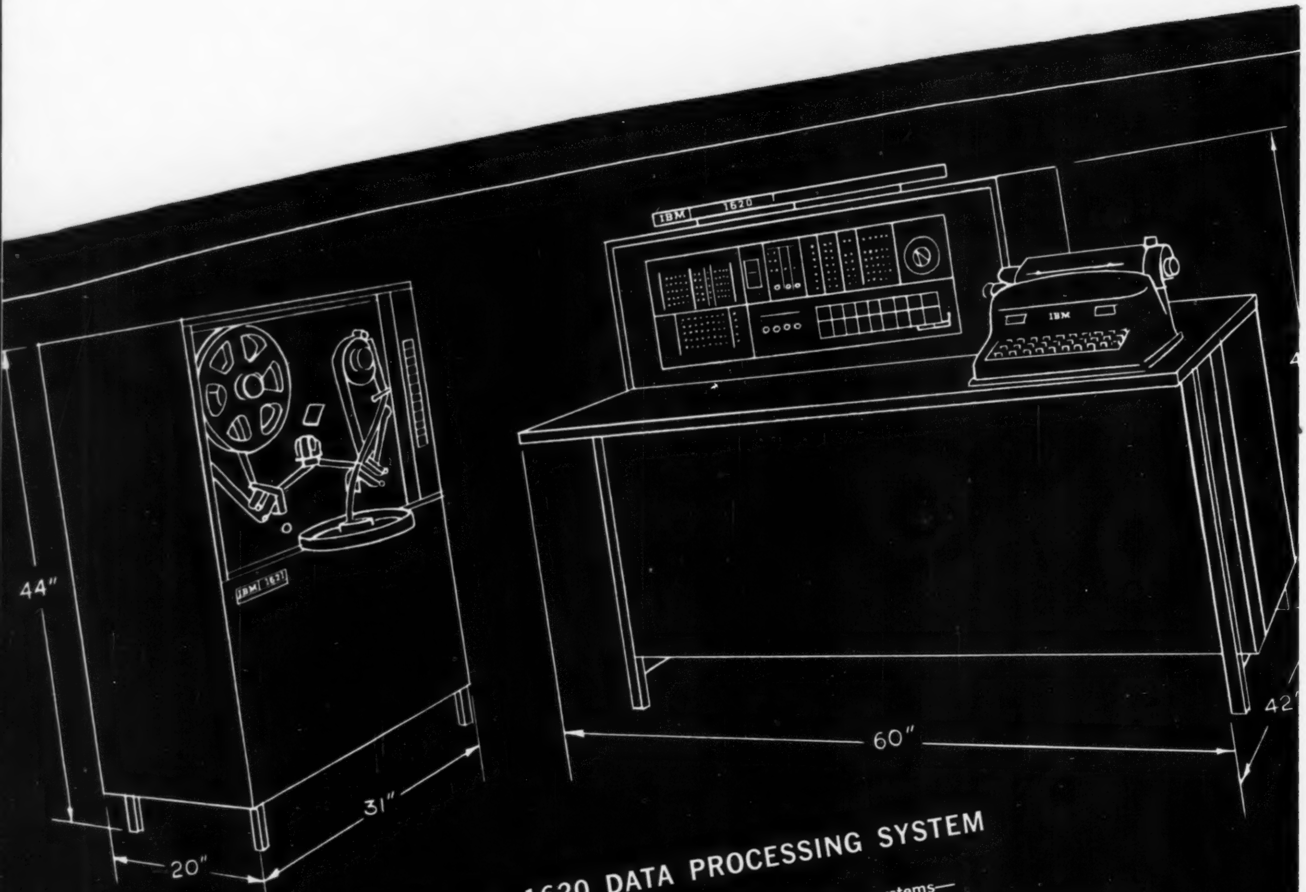
Applications for Admission to ASCE, February 27-March 26, 1960

Applying for Member

NASSER AMIR-FAZLI, Chicago, Ill.
EDWARD CHARLES BATHER, JR., St. Paul, Minn.
GEORGE RICHARD BEATY, Santa Fe, N.Mex.
ALLAN VAN BUREN BEERS, New York, N.Y.
JAMES EDWARD BENNETT, JR., Youngstown, N.Y.
LASZLO BERKE, Dayton, Ohio
HARRY VICKORY BLAND, Kansas City, Mo.
WILLARD RILEY BOLTON, Kansas City, Mo.
JOHN WALTER BRADSTOCK, Toronto 12, Ontario, Canada
JOSEPH HALL BUCKLE, Fresno, Calif.
WILLIAM HENRY CASEY, London, England
ANNADANA SUBRAMANYA IYER CHANDRASEKHARAN, New Delhi, India
DER-REUNN CHARNG, Taiwan, China
EDWARD CHEW, Los Angeles, Calif.
LAURITS NEWELL CHRISTENSEN, Philadelphia, Pa.
JOSEPH MILLER CLARK, Kansas City, Mo.
JOHN ROSE CLARKE, Corpus Christi, Tex.
GENE RAYMOND CUDNEY, East Lansing, Mich.
KENNETH IVAN DARMER, Pierre, S.Dak.
RALPH LEE DAVENPORT, New Orleans, La.
JOHN ROBERT DAVIS, Boston, Mass.
RUDOLPH FREDERICK DUELFER, JR., Jacksonville, Fla.
THAKKOLAM DURAIRAJ, Washington, D.C.
KARL FREDERICK EBERLE, Kansas City, Mo.
FRANK ELVIDGE, Detroit, Mich.
NORMAN C. FOOTE, Baytown, Tex.
JAMES ANDREW GILCHRIST, Cleveland, Ohio
SATISH CHANDRA GOYAL, Jodhpur, India
WILLIS ROSWELL GREER, Seattle, Wash.
KENELM LEE GUINNESS, Washington, D.C.
GEORGE EDMUND HANRAHAN, Chicago, Ill.
GEORGE BRADDOCK HENDRICKS, Los Angeles, Calif.
JOHN RAYMOND HENNEMUTH, Scranton, Pa.
EDWARD JOHN WILSON HENRY, Penarth, Glam., Wales
JACK ALONZO HENSHAW, Nashville, Tenn.
WILLIAM LEE HINDS, Prairie Village, Kans.
DONALD EUGENE HOOD, Virginia Beach, Va.
PAUL NOBLE HOWARD, JR., Greensboro, N.C.
ROBERT HOWELL, Valley Stream, N.Y.
CLYDE WARREN HUBBARD, Boston, Mass.
NOVIE OLIN HUDSON, Rolla, Mo.
WILLIAM ALBERT JACOBY, Allentown, Pa.
ELMER ALBERT JOHNSON, Chicago, Ill.
HENDRIK JONGSMA, Harrisburg, Pa.
GEORGE KATAVOLOS, Tehran, Iran
CHIN-TE KENG, Taiwan, (Formosa) Republic of China
STEPHEN P. KERESTES, Emsworth, Pa.
WILLIAM EUGENE KINDEL, Alexandria, Va.
I-CHI KING, Taoyuan, (Formosa) Republic of China
RAY ERNEST KLINGLER, Zulia, Venezuela
ROBERT JAMES LABURN, Johannesburg, South Africa
ATLURU LAKSHMANASWAMY, Madhya Pradesh, India
HERRICK JOHNSON LANE, JR., New Orleans, La.
DANIEL MORRISON LAZAR, New York, N.Y.
ROBERT CHARLES LOBNER, Kansas City, Mo.
MILO MALLETT MATTHIES, Kansas City, Mo.
THOMAS ZERE McDANIEL, Houston, Tex.
KENNETH SAMUEL McLEAN, Bluewater, N.Mex.
ROBERT AARON MEISENHEIMER, Kansas City, Mo.
EDMUND MERZ, Staten Island, N.Y.
EDWIN THADDEUS MORRIS, Roslyn Heights, N.Y.
AUGUST FREDERICK MULLER, East Orange, N.J.
HAROLD CYRIL MUNN, Los Angeles, Calif.
JAMES RICHARD MURPHY, Wooster, Ohio
DEVARAYASAMUDRAM VISWESWARAIAH SRINIVASA MURTHY, Bangalore, India
ANTONIO DIAS FERRAZ NAPOLES NETO, Sao Paulo, Brazil
ANGUTHA MUDALIAR NATESAN, Madras, India
ROBERT SAMUEL NEDELL, Denver, Colo.
DONALD LEO NEWTON, Monroe, La.
HARRY TILGHMAN OCHS, JR., Boston, Mass.
RIPDAMAN SINGH PANESAR, Lawrence, Kans.
ERIC EMANUEL PHIPPS, Port of Spain, Trinidad, B.W.I.
DENNISON JOHN PICKERING, Montreal, P.Q., Canada
SRINIVASA PRAHLADA RAO, Newark, N.J.
BENJAMIN FRANKLIN ROSE, JR., Covina, Calif.
HARRY JACKSON ROSS, Miami, Fla.
ROBERT BRUCE SHANNON, Kittanning, Pa.
VERNON OTTO SHUMAKER, Vestal, N.Y.
KARL BRYANT STALLINGS, Nashville, Tenn.
THEODORE GEORGE STEIMER, New York, N.Y.
IRVIN HAROLD STURM, Detroit, Mich.
JAMES JOHN SPINELLI, Wayne, Pa.
CARL EDWARD STEELE, Norman, Okla.
JOHN TEN BOSCH, Detroit, Mich.
ANTON GEORGE TREIBER, Berea, Ohio
FRANCES XAVIER TURCOTTE, Boston, Mass.
ALVIN PHILIP VINITSKY, New York, N.Y.
JOHN EARL WAGNER, Maracaibo, Venezuela

(Continued on page 134)


CB&I
WATERSPHERE
...A Working Landmark
The colorful gas flames painted on this towering CB&I Watersphere easily identify the headquarters of Northern Illinois Gas Company's Joliet (Ill.) district.
The aluminum painted landmark is 75 feet to the bottom. It stores 40,000 gallons of water for general use, drawing its supply from a deep well.
Waterspheres . . . and all other modern CB&I elevated tanks are the products of CB&I's *Co-ordinated Services* . . . a single source and responsibility for design, fabrication and erection. The result is *Craftsmanship in Steel*, skillfully developed over more than seven decades of experience.
For additional information write our nearest office.
CHICAGO BRIDGE & IRON COMPANY
CB&I
332 SOUTH MICHIGAN AVENUE
CHICAGO 4, ILLINOIS
OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD
E 65 CB



SPECIFICATIONS: IBM 1620 DATA PROCESSING SYSTEM

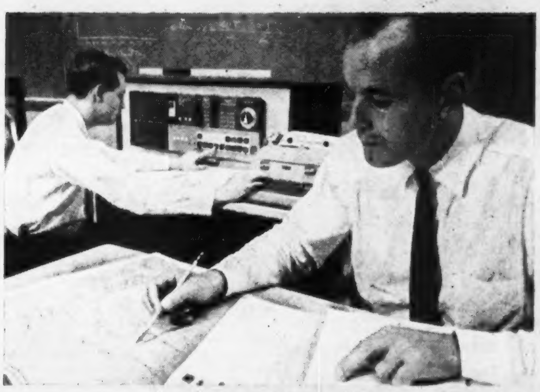
Core storage—20,000 digits
Automatic operation—stored programming
High computing speed—20 microsecond machine cycle
Powerful instructions with two data addresses
Decimal and alphabetic
Variable field and record length—any size numbers

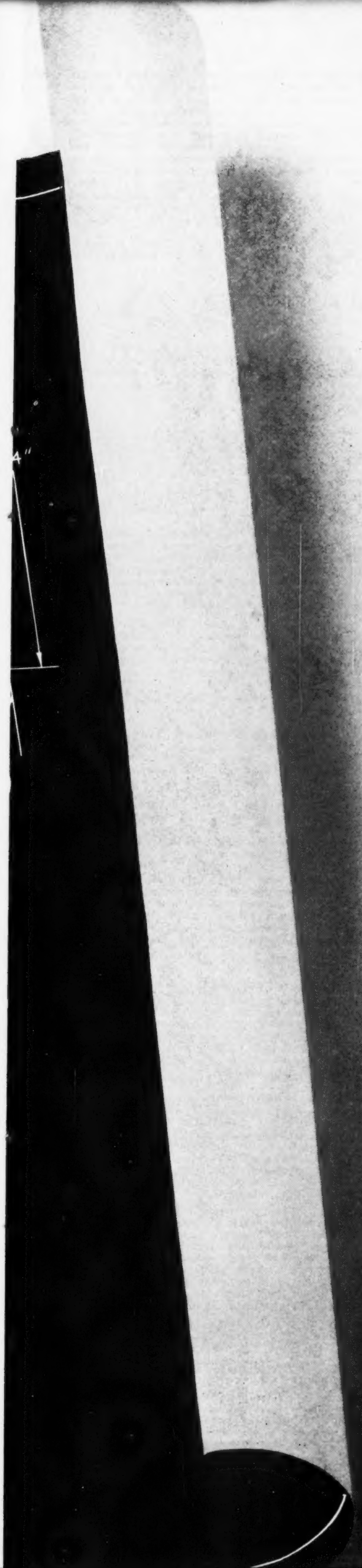
Advanced programming systems—
Fortran and symbolic programming
Compatibility with other computers through Fortran
Simple console with logging features
Self checking throughout
Transistorized circuitry—
compact, economical, reliable
Paper tape input and output

The 1620 will meet technical computing requirements too complex for the conventional desk-type calculator. It provides many advantages of larger systems at a much lower cost. In addition, it can be used to support other data processing systems such as the IBM 650, 704, 705, 709, 7070 and 7090.

Information enters the system from the typewriter of the 1620 Central Processing Unit, or from the 1621 Paper Tape Reader. Output is to the typewriter or 961 Tape Punch.

Machine	Weight in lbs.	Current Requirements	Power cord	Interconnecting cable	Heat Load Specification BTU/Hr
1620	1,000	20 Amps., 115 Volts, single phase 10 Amps., 230 Volts, single phase 6.5 Amps., 208 Volts, three phase	10'3-Wire for 115 and 230 Volts 10'4-Wire for 208 Volts	10' signal 10' power	5,000
1621	280	——	——	——	2,000





ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

(Agency)

New York	CHICAGO	SAN FRANCISCO
8 W. 40th ST.	29 E. MADISON ST.	57 POST ST.

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

Men Available

PROJECT ENGINEER, M. ASCE, M.C.E., 36. Eleven years of experience in all phases of highways and bridges including planning, designing, detailing and inspection of construction with particular emphasis on structures, soil and foundations. C-536.

CIVIL ENGINEER, DESIGN, FIELD OR SALES, bachelor in engineering, with ten years experience including three and a half years' designing highways, airports, municipal, seaport, industrial structure and piping. One year as instructor of engineering mechanics at major Eastern university, five and a half years, construction of refineries, gas plants, highways, municipal, including three years' in Latin American design and construction. Fluent Spanish. C-537.

RESIDENT CIVIL ENGINEER, ASCE, M.S. in C.E. Five years' design and construction supervision. Location desired New England. C-538.

CIVIL ENGINEERING, FACULTY, F. ASCE, M.S. in C.E., Professional Engineering License—New York State, 52. Thirty years with Army Corps of Engineers, designing and constructing flood control works, cantonments, bridges, airfields. Site planning. Supervised engineering education. Location desired, East or West Coast. C-539.

STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E., M.S.C.E., E.I.T. N. Y. Three years of experience; structural design, structural research, chief-of-party, land subdivisions and road layouts, draftsman, report writing and estimating. Working knowledge of latest design methods (plastic and ultimate strength, computer programming, etc.) with all structural materials. Location desired, domestic. C-540.

STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E., N.Y.P.E. License. Two and a half years as stress analyst for major aircraft company, plus four and a half years' of diversified experience as a structural engineer for a consulting engineer. Location desired, New York. C-541.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 26. Three years of office and field experience in heavy construction for general contractor. Military servic complete. Excellent college academic record. Strong interest in soils and foundation engineering. Location desired, Western Pennsylvania. C-542.

CIVIL ENGINEER, M. ASCE, B.S. in C.E., M.S. in Building Construction, E.I.T. Certificate—N.Y. Two years of varied experience in design and specification writing, 18 months' construction supervision on one family homes, subdivision work. Location desired, Foreign. C-543.

DESIGNER in sub-division or site development drainage, A.M. ASCE, B.C.E. Three years of experience in municipal engineering including drainage and street design, some highway work. Location desired, Central New Jersey. C-554.

CIVIL ENGINEER, A.M. ASCE, 26. Traffic research —three months'; detailing—six months'. Recent graduate interested in part outdoors work. Have some experience in sales and supervising men and projects. C-1070—Chicago.

STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E., M.S.C.E., 27. Two years of teaching structures and surveying, one year of designing reinforced and prestressed concrete structures, three years as Navy diving and salvage officer, and one half year designing drainage structures Location desired, Midwest, West or Foreign. C-1074—Chicago.

CIVIL ENGINEER, A.M. ASCE, B.S. in C.E., 26. Three years' oil refinery design and construction, two years' post engineer, U.S. Army and one year summer surveyor for highway department. Location desired, West, Midwest or Foreign. C-1082-Chicago.

CIVIL ENGINEER, A.M. ASCE, B.C.E., 28. Two years' in bridge design with highway department. Summer experience in street construction. Military experience in soils surveys and testing for large air base. Will relocate. C-1069—Chicago.

STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E., 29. Sixteen months' bridge design. Interested in structural design work with consultant or private industry. Location desired, South and Midwest. C-1068—Chicago.

SOILS AND FOUNDATIONS ENGINEER, Student Chapter Member ASCE, B.S. Geology, B.S.C.E., 27. Desire soils and/or foundations work, site investigation, engineer geology, or related fields. Two summers soils testing and classification for earth dam and airfield construction, two summers survey work on roads and drainage improvements. Available June. Location desired, Northwest or Midwest C-1056—Chicago.

SUPERINTENDENT, A.M. ASCE, C.E., Illinois, Registered Professional Engineer, 41. Nine years of experience in charge of work schedules, estimates, field layouts, all phases of construction and administration on buildings, residences, for contractors and consultants; five years as research engineer for miners and manufacturers of insulation, and two years as railway bridge inspector. Salary, $10,000 a year. Location desired, West. Se-1540.

STRUCTURAL DESIGNER, M. ASCE, CE, Licensed CE in California, 41. Three years as consultant on industrial and commercial building design, two years as lecturer on architecture; and twelve years' coordinating consultants, budgets, field supervision, specifications, structural design, stress analyst on buildings, steel mills, ordnance equipment. Salary, $9,600-$10,800 a year. Location desired, San Francisco Bay Area. Se-497.

SANITARY ENGINEER-INDUSTRIAL HYGIENIST, A.M. ASCE, Lic. CE, 28. Seven years of experience in water-waste treatment, public health engineering, heavy industry safety. Proven supervisory and contact ability. Salary, $8,000 a year. Location desired, Southwest, South. Se-315.

FIELD AND OFFICE ENGINEER, A.M. ASCE, CE, EIT, 27. Two years on field survey, erection, contract owners and subcontractors, schedule on structural steel and erection for general contract jobs and fifteen months as detailer on drawings for shop fabrication, structural steel. Salary, $6,300 a year. Location desired, San Francisco. Se-1694.

DESIGNER, PLANNING ENGINEER, F. ASCE, CE. Registered CE in California and Colorado, 57. Thirty years of experience in charge of design, coordination, underground and surface water development on hydro development, power, irrigation, drainage, utilities, river control, both domestic and foreign. Salary, $12,000 a year. Se-1670.

DESIGNER, ADMINISTRATOR, M. ASCE, CE, 34. Fifteen months design-draft highways, subdivision, four years design, supervise highways, airfields, drainage, and four years bidding, estimates, field management of construction. Salary, $9,100 a year. Location desired, San Francisco, Northwest, Overseas. Se-1606.

CONSTRUCTION SUPERINTENDENT, A.M. ASCE, CE, 29. Solid academic training. Four years of heavy construction experience plus additional study in business administration. Good relations with supervisors and subordinates, state personnel and union representatives. All quantity work, form and falsework design, cost reports, schedule of subcontracts and material purchase, take-off work and pricing for large structures. Salary, $7,800-$9,600 a year. Location desired, San Francisco Bay Area. Se-1530.

SUPERINTENDENT, CHIEF ENGINEER, A.M. ASCE, CE, 33. Seven years of experience supervising survey, design, inspection of construction of foundations, buildings, plants, pipeline systems, roads, economic engineering studies for petrol products, also four months on structural analysis of aircraft components. Salary, $10,000 a year. Location desired, South, West. Se-1541.

OFFICE AND FIELD ENGINEER, A.M. ASCE, StructE, 31. Four years making plans and missile site selection studies for consultant; one year as superintendent making cost estimates, negotiating contracts, field surveying on construction of tract homes; and two years Navy, construction of military bases. Salary, $12,000 a year. Location desired, Foreign. Se-1492.

OFFICE, FIELD, MAINTENANCE: ASCE, CE, 51. Five years experience review contracts, coordinate design, supervise construction, planning, maintenance, operations on harbors, flood control works, government projects, military bases. Five years chief of repairs and utilities maintenance, operation of Army posts, including sewage treatment plant. $8,800. Location desired, San Francisco Bay Area. Se-1476.

CIVIL AND INDUSTRIAL ENGINEER, A.M. ASCE, CE, 34. Three years' industrial facilities for Air Force, conveyor systems, plant layouts, material handling equipment, flow and process diagrams; five years' design, construction and maintenance on bulk plants, service stations and facilities for oil company; and two years' design, survey of track alignment for railroad. Location desired, Southern California. Se-1414.

Positions Available

ASSISTANT PROFESSOR, graduate civil, with two to five years of field and office experience in highway, design, construction and survey. Teaching experience highly desirable. Should be qualified to teach surveying, highway plan reading, highway drafting and layout, highway design. Salary, $6,020-$7,520 a 10-month academic year. Extra

compensation for evening school instruction. Location, New York suburban area. W-8886.

SANITARY ENGINEER, graduate, with experience in design of pumping station, sanitary sewer systems, treatment plants, and design water distribution, for consulting engineering firm. Salary, about $10,000 a year. Location, Virginia. W-8882.

CONSTRUCTION ENGINEER, for large multi-plant producer of chemicals and minerals, to design or collaborate in the design of pilot plants, new facilities and alterations to existing facilities applicable to all phases of the production of inorganic chemicals. Travel as required. Salary, $15,000-$18,000 a year. Headquarters, Chicago, Ill. W-8873.

CIVIL ENGINEER to design sanitary engineering and structural features of water treatment plants and sewage disposal plants. Good understanding of sanitary engineering processes required and ability to write reports very desirable. Registered engineer preferred but will consider one who is willing and able to pass exam. Salary, $7,000-$9,000 a year. Location, Georgia. W-8856.

GENERAL SUPERVISOR, operations and mechanical maintenance, graduate mechanical or civil, with experience in materials handling field with conveyors, crushers, loaders, etc.; desirable experience as outside machinist in rigging or general construction; supervisory experience in above. Will coordinate and direct operations and maintenance of ore-handling system on a three-shift operation and be responsible for car dumper, primary and secondary crushers, belt conveyor system, stockpile, Sauerman scraper, rotary plow and ship loader. Working knowledge of Spanish desirable. Salary, to start, $11,088 a year. Location, South America. F-8818.

CITY ENGINEER, graduate civil, also qualified as a traffic engineer, for a medium sized city planning a storm sewer program, street improvement program and an active urban redevelopment program. Should be able to take over a city engineering department and departmentalize it to operate more efficiently. Location, Pennsylvania. W-8813.

PROJECT DESIGN ENGINEER, graduate CE or Sanitary engineering design or related field. Some construction experience desirable for preliminary planning and design of low packaging type sewage plants. Location, Missouri. C-7985.

ENGINEER for a consulting engineering firm specializing in city and regional planning who are qualified for the following: (1) civil engineering; (2) utility planning; (3) hydrology; (4) water resources study; (5) land development; (6) site planning; (7) economic studies; (8) city planning activities. Location, Pennsylvania. W-8722.

Research Engineer, B.S.M.E. or C.E., with two or more years of experience in development of new products, structural analysis and design. Must be able to direct development work from conception through analysis and experiment to production stage. Creativity, analytical ability, and cooperation with production and marketing personnel desirable for a manufacturer of metal and plastic. Salary to $12,000 a year depending on experience. Employer will pay placement fee. Location, Chicago Loop. C-7984.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

RECENT GRADUATE DESIGN ENGINEER, should know AISI light gage design fundamentals to assist the senior design engineer in the design and development department engaged in furthering a good line of construction products and developing new ones. Present major products including buildings, several leading highway products and doors and frames. Salary, to $6,400 a year. Location, Ohio. C-8047.

ASSISTANT PUBLIC WORKS DIRECTOR, CE, California Registration as CE. Ten years of professional experience, including five years in top level supervisory or administrative capacity. Thorough knowledge of civil engineering, engineering economics, able to organize, plan, staff, direct and control public works department. Newly created position. Salary $12,000 a year. Location, Southern California Coast County. Sj-5177.

DESIGNERS, (a) CE with professional registration in California and five years of experience to head hydraulic section with responsibility for water program. Salary, $9,000-$10,900 a year. (b) CE to assist with supplemental water program, collect hydrological field data, ground water, land use and other investigations, compile data and prepare reports on water supply, diversions, utilization. Salary, $6,075-$7,400 a year. U.S. Citizens required. Location, Southern California. Sj-5153-R.

DESIGNER, must have experience in sanitary engineering covering sewage and water treatment plants, sewage, etc., for consultant. Salary commensurate with experience and ability. Location, San Francisco. Sj-5151b.

CHIEF ENGINEER, DESIGNER, ESTIMATOR, ME, CE or equivalent, under 50. Structural experience and knowledge of feed, flour, fertilizer and chemical industries desirable to prepare complete industrial layouts, for long established small firm of industrial engineers and contractors. Capable of handling design, selection and purchase of machinery, equipment and materials; field supervision, estimating costs of machinery, contact and negotiate with clients. Salary, $10,000 potential. Headquarters, San Francisco. Sj-5136.

ESTIMATOR, CE or construction background, young. Will assist in estimating, taking off and preparing bids on highway construction, underground, streets, alleys and parking areas; largely grading, paving, earthmoving and surfacing for a contractor working on airfields, municipalities, etc. U.S. Citizen required. Salary, $6,000-$7,200 a year. Location, Sacramento. Sj-5123.

ARCHITECTURAL DESIGNER, to design, engineer and estimate commercial and industrial buildings and facilities and design products manufactured such as store, library, lab, restaurant, bank and miscellaneous institutional furniture, equipment and fixtures. Salary commensurate with ability, experience and productivity. Location, Central California. Sj-5115.

CONSTRUCTION FOREMAN. Several years of civil engineering training, or five years of recent experience as construction foreman for general contractor in subdivision development, highway construction, underground (water and sewer) and concrete structures. Must be able to write reports legibly and effectively and supervise crew, time records, materials, progress reports under general superintendent. Apply by letter. Salary open. Location, Central California. Sj-5113.

Field Representative

TRADE ASSOCIATION has opening for graduate engineer with five to ten years experience in water utility or related field. Requires aptitude for technical sales promotion work. Travel within limited territory. Car furnished and all expenses reimbursed.

▲

Applicants should submit complete resume of experience to Box No. 299.

RECENT BOOKS

(added to the Engineering Societies Library)

Le Boulonnage Des Roches En Souterrain

The "boulonnage" or "bolting" discussed is a new technique for shoring roofs and walls of underground excavations in rock. Long bolts driven into the rock face outwards from the excavation secure flat, metal washers and often a large-mesh heavy metal screen against the rock face. The advantages, methods and materials of this technique are given, with illustrations of applications. The mathematical theory basic to it also is given, permitting assessment of its value in any specific application, and selection of the most effective type of bolt. (By André Hugon and André Costes. Edition Eyrolles, Paris, France 1959. 179 pp., paper. 2,900 Francs.)

Cathodic Protection

This practical book on the prevention of corrosion by electrolytic means, describes the making of the necessary field surveys and tests, the interpretation of test results, and the design and construction of the appropriate cathodic protection installations. Operational examples of the protection of such underground and submerged structures as pipelines, cables, aviation fuel tank and line systems, lock and dam gates, and ships in storage are given. Also included is an examination of the relationship of cathodic protection, to static and power grounding systems. (By Lindsay M. Applegate. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 229 pp., bound. $9.00.)

Cathodic Protection

The technique of the electric method of corrosion prevention, rather than the electrochemistry of the interface, is the subject of this English textbook on cathodic protection. The first part of the book is devoted to the methods and the factors involved in this method of prevention; the second part considers the procedures in achieving protection in a variety of structures, such as buried pipes and tanks, structures in sea water, structures containing interference corrosion. Instruments for cathodic protection and the economics of this method are dealt with in the last chapters of the book. (By John H. Morgan. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1960. 325 pp., bound. $12.00.)

Chemical Analysis

Volume X

Methods given here for the determination of the kind of air contaminants include general methods for sampling and for determination of volume, quantity and velocity of air and gas; analysis of settled and of suspended particulate matter; and analysis of gaseous and vapor contaminants. Methods also are given for determination of the amount of pollution emitted by any given source, such as chimneys, motor vehicles, and incinerators, and evaluation of effectiveness of abatement devices. The final chapter examines air pollution monitoring devices such as sequence absorbers, multiple gas samplers, and autometers. (By Morris B. Jacobs. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y., 1960. 430 pp., bound. $13.50.)

Data Book for Civil Engineers, Volume I: Design

Third Edition

A concentrated, tabular and illustrated collection of design data for civil engineering structures, with new material in this third edition in the sections on structural steel, concrete, wood, aluminum and masonry; wind pressures on structures; pavements, highways, airports, bridges and waterfront structures; and in drainage and sewage systems. All sections have been revised in accordance with the latest data, codes, standards, and practice. (By Elwyn E. Seelye. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960. Various pagings, bound. $24.00.)

Electronic Computers

Second Edition

A British book also published in the United States, this book gives a non-mathematical general introduction to the principles and applications of computers employing tubes, transistors and other electronic devices. Almost entirely rewritten with new diagrams and equipment photographs, this edition includes new chapters dealing with analog computer circuits, the programming of digital computers, and the evolution of the "intelligent" machines of the future. (By T. E. Ivall. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 1960. 263 pp., bound. $10.00.)

Grosse Dampfkraftwerke, Planung, Ausfuhrung Und Bau, Kraftwerksatlas

Band I

This first volume of a comprehensive work on large steam power stations is a "Power Station Atlas" containing concise, illustrated descriptions of ninety-eight power stations all over the world. There are large chapters on the Eddystone power plant and the TVA plants, as well as on power stations in Germany, Italy and Argentine. Part II, when published, will deal systematically with the design and construction of power stations in general. (Edited by Karl Schröder. Springer-Verlag, Berlin, Germany, 1959. 1073 pp., bound. 192 DM.)

Highway Engineering Handbook

Written by specialists in each field, the 28 sections in this comprehensive book cover almost every aspect of highway engineering with the primary exception of structures. The first part covers highway administration, finance, planning, economics, route selection, photogrammetry, computers and traffic engineering. Soil testing, exploration, drainage, earthwork, frost, foundations, slopes, etc. are treated in part 2. Part 3 deals with contracts, specifications, soil stabilization, Portland concrete and bituminous materials and mixes. Part 4 includes design and construction of rigid and flexible pavements, highway maintenance and landscaping. (Edited by Kenneth B. Woods and others. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. Various pagings, bound. $25.00.)

Marine Corrosion Handbook

Here is practical guidance, for non-specialists, on the prevention of corrosion in ocean-going ships, with the view toward application rather than scientific theory. Arranged alphabetically, the book gives rules of thumb for the choice of metals, the use of plastics for metal protection, and information on season cracking, stress corrosion, cathodic protection, anodic cleaning, corrosion fatigue, mechanical descaling, and special pertinent qualities of each of the most commonly used metals. (By T. Howard Rogers. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 297 pp., bound. $12.50.)

Methodes Generales D'Essai Et De Controle En Laboratoire

Livre 1, Mesures Géométriques et Mécaniques

A volume in a series on testing materials of construction, this book deals with laboratory methods and control, covering such general subjects as organization, use of statistics, instruments, etc. It also covers geometrical and mechanical measurements of length, surface, volume, mass, time, force, and deformation, and includes two chapters on extensometers. Comprehensive author and subject indexes are provided, and there is a bibliography arranged according to chapters. (By Robert l'Hermite. Editions Eyrolles, Paris, France, 1959. 739 pp., bound. 9,700 francs.)

(Continued on page 132)

Recent Books

(Continued from page 131)

Midwestern Conference on Fluid Mechanics Proceedings, 1959

Aerodynamics, heat transfer, characteristics of hypersonic and tangent flow, shock waves, boundary layer conditions, lubrication, and wave motions are the general areas covered by the thirty papers in this volume. Specifically, papers deal with such topics as secondary flow in straight open channels, theoretical and experimental study of heat transfer by cellular convection in the presence of impressed magnetic fields, an extended Reynolds analogy, and scale effects in turbulent shock wave boundary layer interactions. (Published by the University of Texas, Austin, Tex., 1959. 465 pp., bound. $12.50.)

Midwestern Conference on Solid Mechanics Proceedings, 1959

Papers in this volume indicate the directions of analytical research and fundamental experiments in the field of solid mechanics. The twenty-nine papers included range from basic topics such as the impact of cylinders of different areas and the collapse load of a spherical cap to specialized treatments of spin dynamics of a thrusting rocket in a vacuum and bending waves in free-free beams. (Published by the University of Texas, Austin, Tex., 1959. 530 pp., bound. $12.50.)

Notes: Basic Engineering Sciences

Fourth Edition

A brief review of engineering fundamentals with answers to 200 problems, asked in the New York State Board Examinations for the Professional Engineering License, are contained in this book. This fourth edition has been enlarged to include several new subjects and much of the text has been rewritten. It has been found helpful as a reference book for those working in industry as well as for home study for the Board examinations. (By C. E. Harrington. Published by author, 45 Elk Street, Springville, N. Y., 1959. 169 pp., paper.)

Nuclear Power Plant

A review of the basic ideas underlying nuclear power generation for the informed reader. It opens with a concise account of world energy requirements and resources in the present and in the future and goes on to deal with nuclear and reactor physics and reactions, types of reactor according to different means of classification, reactor engineering based on the unique reactor physics, the control of the heat output of the reactor, instrumentation, and economics of nuclear stations. The appendices contain comprehensive tables of elements, neutron interaction formulae, reactor theory, and a chronology of nuclear power development. (By E. Openshaw Taylor. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 1959. 184 pp., bound. $7.50.)

Power Station Engineering and Economy

This retitled second edition of the authors' *Applied Energy Conversion* is virtually a new book, although again stressing the study of the power plant as an integrated engineering system. Both thermal and water power stations are covered, with emphasis on the steam plant. Among the recent advances covered are: nuclear energy in power production, gas turbine plants, modern systems of water conditioning, thermoelectric generators, solar energy, and fuel cells. Other features include a complete economy study of power plants, an extensive discussion of super critical steam cycles and large capacity steam turbines, and extensive problem work on heat balance. (By Bernhardt G. A. Skrotzki and William A. Vopat. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y, 1960. 751 pp., bound. $12.50.)

Practical Prestressed Concrete

A compilation of basic principles and procedures in the design of structures of prestressed concrete, with illustrative examples using simple arithmetic and standard stress and moment formulas, in some of which inadequate sections deliberately are used to demonstrate corrective measures. The economy of the section is examined at different stages of design, before it progresses too far. Construction methods and equipment are discussed with emphasis on American practice. (By H. Kent Preston. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 340 pp., bound. $11.50.)

Proceedings of the Second Japan Congress on Testing Materials

This volume contains English editions of sixty-seven of the papers presented at this 1958 Congress by Japanese scientists and engineers. Section 1 contains papers on metallic materials, including steel, cast iron, titanium, zirconium and some alloys. Section 2 deals with such non-metallic materials as wood, concrete, clay, glass, plastics, rubber and synthetic fibres. Section 3 looks at testing methods and apparatus, including an ultrasonic thickness tester, resistance wire strain gauges, and vibrographs. An appendix gives catalogue information on Japanese industry. (Published by the Japan Society for Testing Materials, Kyoto, Japan. Various pagings, paper.)

Sir Casimir Stanislaus Gzowski

The biography of an eminent Polish-born (1815) engineer whose professional life was closely interwoven with engineering developments in Canada. His supervisory job in the construction of the Erie Canal and Railroad, achieved after six years in the United States, led him to Ontario in 1841. Until his death in 1898 he was active in the construction of roads, railroads and bridges, in inland waterway surveys, and in patriotic and community activities, accumulating numerous honors. (By Ludwik Kos-Rabcewicz-Zubkowski and William Edward Greening. Burns and MacEachern, Toronto, Canada, 1959. 213 pp., bound. $4.75.)

Library Services

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by (the Society's initials, eg. ASCE) members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Subsurface Mapping

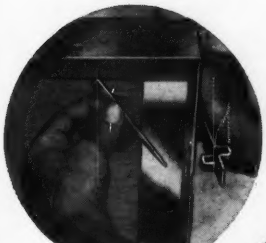
This treatment of the construction and interpretation of geologic maps discusses advances since 1924, primarily the isopach, facies, paleogeographic, paleogeologic, paleotectonic, and palinspastic maps. Major emphasis is given these mapping developments, but the fundamental principles of physics and geology relevant to understanding and interpretation are briefly discussed, and the geological implications of geographical and geochemical maps are explained. (By Margaret S. Bishop. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960. 198 pp., bound. $5.75.)

Wave Propagation and Group Velocity

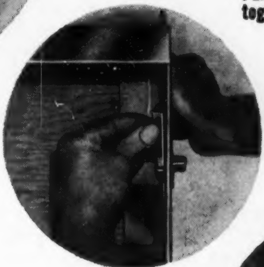
Problems in connection with radio signals and radar, and in wave mechanics, have renewed interest in this field. Lord Rayleigh's definition of "group velocity" raised difficulties with the theory of relativity. This led to papers and discussions of the problem around 1910, and other definitions such as Sommerfeld's "signal velocity," and also the "velocity of energy transfer." Original papers and discussions pertinent to the evolution of these definitions, and applications such as guided waves, are presented in this book. The author has been closely connected with the development of wave propagation theories. (By Léon Brillouin. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y., 1960. 154 pp., bound. $6.00.)

simple
tie
installation...

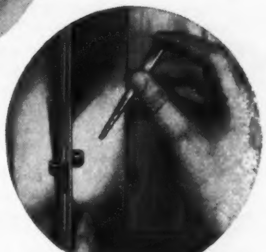
secret of FASTER CONCRETE FORMING



1. UNI-FORM Tie Loop placed in square tie hole of Panel.



2. Tie Key set into the Tie Loop. Panel and Tie are now locked together into integral unit.



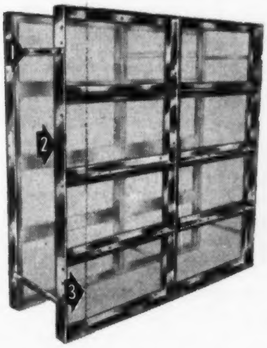
3. Next UNI-FORM Panel is placed in position. Tie Loop automatically enters square tie hole. Key is dropped in—assembly is complete. NO COMING BACK TO "FISH" TIES.

When you can tie and lock two concrete form panels in a few seconds, you're forming concrete fast! This is exactly what you can do with the UNI-FORM Panel System—the fastest system of forming concrete ever developed.

Faster tieing is only one of many UNI-FORM Panel features that makes them *the* pre-fab forms contractors are using on every kind of concrete construction. Write for the UNI-FORM Panel System Catalog and full details . . . or, call your nearby Universal Distributor or Branch Office for personal attention immediately.

SECONDS TO INSTALL **UNI-FORM** TIE AND ASSEMBLE PANELS

UNI-FORM PANELS ERECT INTO A TIGHT, RIGID, AUTOMATICALLY ACCURATE CONCRETE FORM



1. Ties spread, lock UNI-FORMS into a form with automatically accurate wall thickness.
2. Steel frame provides structural strength and rigidity. Minimum alignment and bracing.
3. Best Exterior Grade Plywood face provides nailing surface. Easily turned for further re-uses.

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ATLANTA BALTIMORE CLEVELAND HOUSTON
LOS ANGELES SAN LEANDRO TORONTO

Applications

(Continued from page 124)

William Whitfield Watkins, Dillsburg, Pa.
Cecil Harold Wells, Jr., San Mateo, Calif.
Robert John Wening, Dayton, Ohio
John Alden Woodworth, Tacoma, Wash.
Joseph Chew-Chao Wu, Allen Park, Mich.
George Yamane, Seattle, Wash.
Robert George Zilly, St. Joseph, Mich.
Chester Jerome Zimniewicz, St. Paul, Minn.
Robert Burns Zinser, San Pedro, Calif.

Applying for Affiliate

Wayne Clinton Brock, Minneapolis, Minn.

Applying for Associate Member

Naim Tawfik Afis, Baton Rouge, La.
Krishnakumar Aparhai Amin, New York, N.Y.
John Robert Anglum, New York, N.Y.
Marlin Ralph Barton, Sacramento, Calif.
Robert Allen Bendigo, Bethlehem, Pa.
Vithalbhai Trikambhai Bhagat, Minneapolis, Minn.
Giorgio Bugliarello, Pittsburgh, Pa.
Walter Comack, Denver, Colo.
Jose Rafael Capo-Lopez, Mayaguez, Puerto Rico
Ramon Joseph Cook, San Antonio, Tex.
William Authur Corn, San Diego, Calif.
Shreeram Kashinath Damle, Boulder, Colo.
Guenther William Engel, Albany, N.Y.
Hugh John Ferguson, Parma Heights, Ohio
John Wait Flood, Boston, Mass.
Victor Manuel Guevara, Caracas, Venezuela
Lowell Dean Harris, Eureka, Calif.
Jesus Alfredo Hernandez-Ramirez, Caracas, Venezuela
Chester Creed Kelsey, Mineola, N.Y.
Duk Hyun Kim, W. Lafayette, Ind.
Samuel Morrison King, Ottawa, Ill.
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Manrique Lara-Tomas, Columbus, Ohio
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Neil Lee MacFarlane, Troy, N.Y.
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Nicolas Nouel, Caracas, Venezuela
Chikwendu Nwariaku, Middlesex, England
Daneil Chiekweiro Onyema, Enugu, Nigeria
Suryakant Narsinhbhai Patel, Minneapolis, Minn.
James Reid Pfafflin, New York, N.Y.
Sandor Popovics, Auburn, Ala.
Lloyd Roger Porter, Ogden, Utah
Franciscus Xaverius Prins, Cape Province, South Africa
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John Cecil Sandberg, San Fernando, Calif.
Jagadish Krishnachandra Sant, Columbus, Ohio
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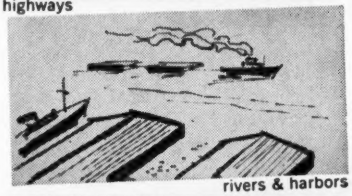
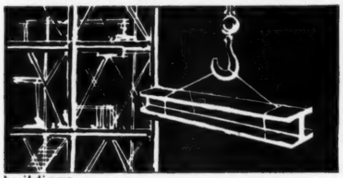
Robert Carl Scharf, Baltimore, Md.
Arthur Eugene Scribner, Jr., Bethesda, Md.
Warren Dewann Seltzer, Long Beach, Calif.
Ismet Sedot Seymen, Forest Hills, N.Y.
Virgil Henry Snell, Kansas City, Mo.
Kandasamy Srinivasan, Boulder, Colo.
John Raynold Stack, Overland Park, Kans.
Gerald Elton Stuth, Minneapolis, Minn.
Manuel Agustin Tovar Giron, Caracas, Venezuela
Luis Felipe Van Dam, Cambridge, Mass.
Hellmuth Friedrich Heyderhoff Weich, Stellenbosch, South Africa
Cheng Yi Yang, Cambridge, Mass.
Muhammed Ali Yusaf, Chicago, Ill.

[Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.]

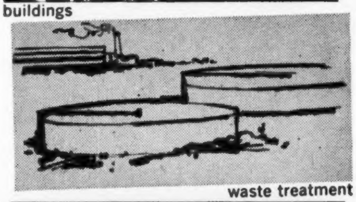
highways



rivers & harbors

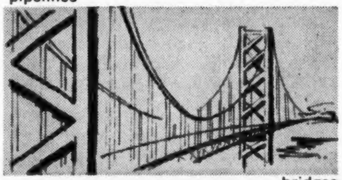


buildings

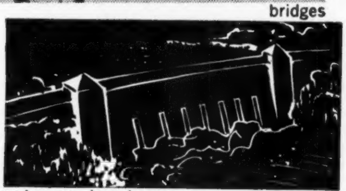


waste treatment

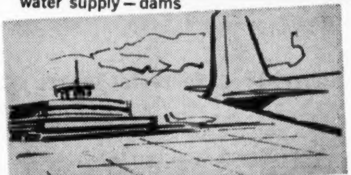
pipelines



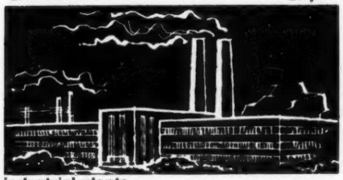
bridges



water supply – dams



airports



industrial plants

WHY ADVERTISING IN CIVIL ENGINEERING STIMULATES SALES IN CONSTRUCTION MARKETS

In the construction industry, four major groups account for nearly all product buying and specifying:

CONSULTANTS ■ CONTRACTORS ■ PUBLIC WORKS ■ OWNERS

Civil engineers occupy key positions in each group. Not only are they responsible for design, construction, operation and maintenance "in the field"... civil engineers are also a primary influence "behind the desk," in charge of management.

As a result of this wide responsibility, civil engineers largely control the specification and purchase of construction equipment, materials and services.

The only magazine edited exclusively to serve the technical, business and professional needs of this select audience is CIVIL ENGINEERING... official publication of the American Society of Civil Engineers.

Year after year, its circulation has increased with construction activity and the growth of the civil engineering profession. Editorially CIVIL ENGINEERING serves all areas of construction and all civil engineering interests – making it truly The Magazine of Engineered Construction.

Basic data on the civil engineer's role in different construction industry groups is being furnished by A.S.C.E. Mail Forum surveys. For example, the most recent study (of consulting engineers) revealed these facts:

■ CIVIL ENGINEERING's consultant readers own or work for firms that concentrate almost entirely on *engineered construction* projects...with their work divided among the various types of construction as follows:

Airports	3.8%	Military sites	3.9%
Bridges	7.6	Pipe lines	4.6
Buildings, commercial & residential	17.9	Rivers & harbors	1.6
Dams	2.7	Waste treatment	10.9
Highways & streets	14.6	Water supply	10.1
Industrial plants	9.1	Miscellaneous	13.2

■ the average annual cost of all the equipment and materials specified by each of the 290 firms reported is well over $6 million.

■ 90% of the readers influence the purchase and the specification of construction materials, installed equipment and office equipment.

■ their titles and functions are proof of a high degree of authority and a wide area of buying influence within their firms.

In CIVIL ENGINEERING, advertisers reach top quality consultants concerned only with construction. This is the core of your consulting engineer market... the men who specify your products!

And remember... whether your product is specified and purchased through consultants, contractors, architects, owners, public works officials (or any combination of these groups) you get the *most effective, most economical* coverage of civil engineers by advertising in CIVIL ENGINEERING Magazine.

Quality circulation guarantees that your product message will be concentrated on men who make the decisions that lead to purchases!... which is why we say, "advertising in CIVIL ENGINEERING stimulates sales in construction markets."

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

ABC 45,000

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

The American Society of Civil Engineers ■ 33 W. 39th St., New York, N. Y.

EQUIPMENT, MATERIALS and METHODS

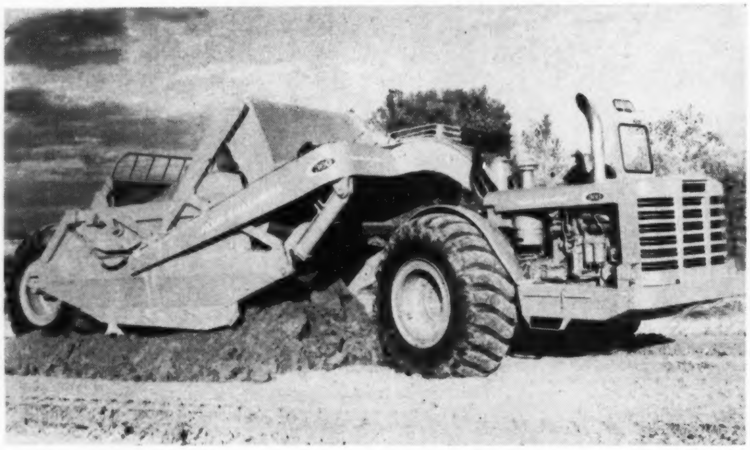
NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Abrasive Crystals

Two NEW ELECTRONIC-SEMI-CONDUCTOR grades of levigated alumina abrasives, "Liquid Sapphire" and "Liquid Ruby", have been announced. These crystals meet the critical requirements of the electronic and semi-conductor industry and will produce the ultra high polished surfaces necessary for advanced device fabrication. Corunda (Liquid Sapphire and Liquid Ruby) is produced under the most exacting conditions assuring a new standard of uniform particle size. Homogeneity is certified by the laboratory analysis of each batch produced. Every run is graded and the particle and size and lot number recorded on the containers.

All Corunda aluminas are manufactured by the batch method in completely closed systems. Only the finest chemicals are employed and deionized-doubly distilled water is used in the levigation process; contamination is virtually impossible, the manufacturer states. **Geoscience Instruments Corporation, CE-5, 425 Park Ave., New York 22, N. Y.**

All-Hydraulic Motor Scraper



AN ALL-HYDRAULIC TS-360 MOTOR SCRAPER with a 30-cu yd heaped capacity and a 22.3 cu yd struck capacity is powered by the turbocharged 21000 engine, developing 340 hp at 2,000 rpm.

Double-acting hydraulic bowl lift jacks assure tremendous force at the cutting edge for penetration into tough-loading materials. Hydraulic power is furnished by a tandem pump, gear-driven from rear of engine crankshaft to provide instant controlled response for positive steering and scraper operations.

The TS-360's double-acting steering jacks and multiplier links provide the unit with exceptional maneuverability. A 90-deg turn either way can be accomplished with only a 1/6 turn of the steering wheel. Full 180-deg turns can be made within a width of 35 ft 8 in.

The big turbocharged engine combines fast acceleration and high torque output for fast get-away in the cut, sustained haul speeds and full power spreading on the fill. The heavy-duty drive train efficiently transmits high engine output to the drive wheels. **Allis-Chalmers Mfg. Co., CE-5, Box 512, Milwaukee 1, Wis.**

Low Cost Ceiling Tile

A NEW TYPE OF CEILING TILE, priced at least 50% lower than other standard ceiling tile materials, is now being offered.

An expanded plastic designed specifically for use in suspended grid-type ceilings, it is white in color and the surface is finished in a subdued striated pattern. The rigid material possesses exceptional insulation properties and is lightweight.

Because of the material's light weight, lighter than usual steel grids can be employed for supporting it, the company states. On the job, the material is easily cut to accommodate vents and irregular shapes. **General Foam Plastics Corporation, CE-5, 801 Mt. Vernon Ave., Portsmouth, Va.**

Lightweight Asphalt Surface Heater

A NEW PORTABLE, LIGHTWEIGHT asphalt surface heater, that can be operated by one man, produces highly concentrated heat in a small area to quickly heat asphalt to a workable consistency, eliminating the need for costly equipment normally used for this type of work.

Available in two models, this compact unit has been specially developed for the repair and removal of asphalt bumps and push-ups, removal of traffic lane lines and for drying pot holes prior to patching. **Essick Manufacturing Co., CE-5, 1950 South Santa Fe Ave., Los Angeles 21, Calif.**

New Stepping Motor

THE DEVELOPMENT OF A NEW Size 5 Digimotor for use as a stepping motor or indexing device with extreme dependability, long life and high torque-to-size ratio has been announced.

Available with 8, 10, 12, 18, 20 and 24 steps per revolution, and in uni-directional or bi-directional models with or without detent, the new stepping motor's design concept gives it many features never before available in the stepping motor field. Mechanical load can be positioned manually in either direction, and direct coupling of shaft to load permits mounting of position indicator on shaft. Shaft extensions are available at one or both ends.

Stepping rate of the motor is 15 to 25 steps per second, depending on the number of positions, load and other factors. The quiet, jam-proof mechanism is completely enclosed in a protective housing, has magnetic anti-overcoat, and is permanently lubricated. Models are available in any duty cycle within operating voltage range from 6 to 350 VDC. **Ledex, Inc., CE-5, 123 Webster St., Dayton 2, Ohio.**

Swivel-Type Concrete Bucket

THIS NEW 3/4-CU YD Concrete Bucket has a swivel of 180 deg, giving a 5-position lock. Mounted on ball bearings, it is easily swiveled by hand. Dumping is completely power hydraulically controlled from the operator's seat.

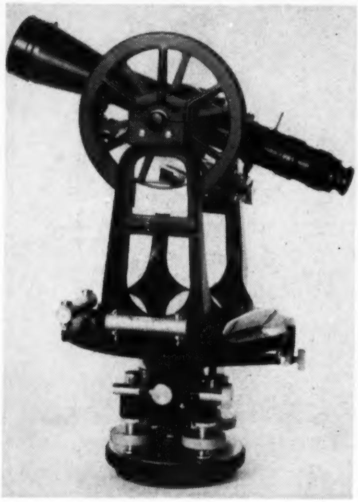
The bucket permits the operator to travel parallel to the forms and discharge his load to either side. When working in close quarters, he can deposit his payload to the right or left. **Lull Engineering Co., CE-5, 3045 Highway 13, St. Paul 11, Minn.**

EQUIPMENT MATERIALS and METHODS

(continued)

New Transit

THE AVAILABILITY OF AN imported, precision, 6¼-in. transit has been announced. Weighing 16½ lb, Model 625 has an erecting, 28-power, 11½-in. telescope with coated lenses, resolving 3.5 sec of arc. The 40-mm objective provides a brilliant image.



Model 625

Horizontal circle is 6¼ in. in dia with graduations reading direct to 20 min, double numbered 0-360 and 360-0, with figures inclined in the direction of increase. Verniers read down to 20 sec. Verticle circle is 5-in. dia graduated to 30 min with a vernier direct reading to one min. **Umeco Optical Division, CE-5, 465 California St., San Francisco 4, Calif.**

Plastic Coating Protects Surface

THE "COCOON" COATING TECHNIQUE used to "mothball" much of the United States fleet is also protecting New York's Solomon R. Guggenheim Memorial Museum from the elements. The special coating provides a waterproof, abrasion-resistant surface.

In addition to protecting the museum from erosion by wind, water, changing temperature and air pollutants, the ivory-tinted vinyl coating highlights the monolithic texture of the concrete surface.

It is jointless, fills the hairline cracks characteristic of poured concrete surfaces, and expands and contracts with the structure itself. It does not oxidize or erode,

(Continued on page 138)

EQUIPMENT MATERIALS and METHODS

(continued)

and architects predict that it will give the museum at least ten years' service before any recoating is required. The building can be simply cleaned by hosing with plain or detergent-containing water.

The coating is a liquid vinyl formulation applied by spraying. Actually a series of coats, it includes a strongly adhesive primer and an outercoat which has great cohesive strength. **Union Carbide Plastics Co., Division of Union Carbide Corp., CE-5, 420 Lexington Ave., New York 17, N. Y.**

Vertical Clinometer

A SIMPLE YET RELATIVELY INEXPENSIVE Clinometer for determining or pre-setting vertical angles up to 180 deg either side of the vertical within accuracies of 1 min or 30 sec of arc is available.

The instrument consists of a 4-in. vertical circle graduated to either 30 or 20 min and a vernier with an adjustable reading glass. A leveling bubble sensitive to 60 sec is securely attached to the vertical circle together with a tangent screw for minute adjustments.

Useful When Optical Tooling Impractical

Angles are determined by leveling the bubble and taking a reading at the vernier; they are preset by swinging the circle to the desired reading and raising or lowering the object until the bubble is level.

The instrument is used for leveling, adjusting or finding errors in machine or parts setups, vertical or angular adjustments of objects not on level base, such as a ship, or in restricted areas when space limitations make optical tooling impractical. **Buff & Buff Mfg. Co., CE-5, 329 Lamartine St., Jamaica Plain, Mass.**

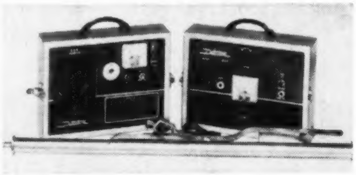
EQUIPMENT MATERIALS and METHODS

(continued)

Transistor Pipe Detector

A NEW TRANSISTOR PIPE DETECTOR, the Detectron Model 808, is now being produced. Inadequacies normally inherent in transistors, such as heat limitations, have been eliminated by the use of special compensating circuitry. Thus the 808 is suitable for use in hot southern climates where heat instability of transistors has previously been a problem.

Two transistors instead of one are used in the transmitter so that maximum power is available with no sacrifice of stability. The biggest advantage of the new instrument over tube instruments is in the tracing of pipes and cables by the conductive method, which is of a partic-


Special Compensating Circuitry

ular advantage in areas where highly mineralized soil is the problem, or where there are many abandoned pipe lines. The cut-off of the 808 is unusually sharp assuring separate detection of pipe lines lying close together.

The detector is designed not only to detect and trace pipes, cables and conduits, but to locate valve boxes, services, studs and miscellaneous metallic objects. The depth of a pipe or cable can usually be quickly estimated by triangulation. Also, if necessary, a pipeline can be located so precisely that it can be marked on the pavement above within an area narrower than the width of the pipe itself. **Computer-Measurements Co., CE-5, 12970 Bradley Ave., Sylmar, Calif.**

Calibrated Ruling Instrument

A NEW WEST GERMAN 12-in. combination triangle, T square and parallel ruler is now available. Built-in rollers allow smooth, easy movement up or down when drawing lines. A spiral index window automatically measures distances between horizontal lines as close as 1/16 in. Vertical lines are simply made by placing pencil or ball point in any hole and rolling ruler up or down. Designers, engineers and draftsmen will find its use fast and easy. Of light weight plastic, it easily fits in briefcase for on the job sketching. **Rol-Ruler Co., CE-5, P.O. Box 164, Riegelsville, Pa.**

Panel Nets

A NEW DEVELOPMENT IN the field of Manila Rope Nets, applying to Safety Nets, Maritime and Cargo Nets and manila rope nets in general, has been announced.

Known as Panel Nets, the objectives of the new construction are: maximum strength and durability, economy of production, and the meeting of Federal and State requirements for safety nets. The principal features are: complete panels of net mesh are laid up with one continuous length of rope; plastic impregnated Fiber Glass lashings secure rope crossings, including mesh and edge ropes, eliminating distortion of rope lay and friction or wear at rope crossings; and the elasticity; adding greatly to strength, results from diamond mash construction and absence of short rope members. **Pedley-Knowles and Co., CE-5, 134 Sacramento St., San Francisco 11, Calif.**

Twin Electrode Welding Torch

A HANDY TOOL FOR use with any A.C. welding machine, the Model B-3 Twin Electrode Torch uses two cored carbon electrodes, easily maintained at proper distance, to produce an electric arc for many heating, soldering, brazing, and welding jobs.

Numerous applications, from the small job shop to large industrial plants, can be found for the tool. It will produce very satisfactory welds as well as production brazing, soldering and heating. Operation is economical since it uses only inexpensive A.C. welding current. Because no gas is involved, costly time consuming cylinder handling is eliminated. **The Arcair Company, CE-5, P.O. Box 431, Lancaster, Ohio.**

New Wheeled Tractor

A CUSTOM ENGINEERED WHEELED TRACTOR, the Blue Ox—Side Boom, has been designed for contractors and gas distributing companies to be used in pipe stringing, lowering-in operations, oil and gas pipeline construction and repair work.

It has been successfully tested and proven under actual conditions found in oil and gas pipeline construction. In

(Continued on page 143)

building the unit from the ground up, the company's engineers were able to lower the center of gravity radically for maximum stability under extreme boom loads. **FWD Corp., CE-5, Clintonville, Wisc.**

Mylar-Duralar Drafting Method

THE MOST FREQUENT COMMENT by engineers and chief draftsmen on the revolutionary Mylar-Duralar drafting method has been on the excellent print quality which can now be maintained consistently regardless of how often the original drawing is reproduced, the manufacturer states. The consensus is that the new method results in prints far superior to those obtainable from tracing paper or cloth, it is further stated.

Mylar-Duralar drawings are tear-proof, smear-proof, easy to revise, and completely waterproof. They eliminate the need for costly re-drawing because fingerprints, grime, and stains can be washed off before prints are made, leaving the Duralar lines sharp and clear for reproduction. **J. S. Staedtler, Inc., CE-5, Hackensack, N. J.**


Wash Off Grime, Stains

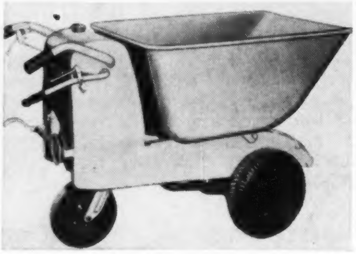
EQUIPMENT MATERIALS and METHODS

(continued)

Prime-Mover Transaxle

A UNIQUE TRANSAXLE POWER transmission designed especially for powered buggy and industrial truck applications, is featured in the Prime-Mover M-15B. Transmission, differential and drive axles are enclosed in one compact housing, and are lubricated from the same reservoir of oil.

No special tools or skills are required for servicing because of the simplicity of design. An internal chain eliminates the need for a reverse idler, and a worm final drive replaces numerous reduction gears.



M-15B

According to the manufacturer, dynamometer tests of the transaxle show that it delivers 10% more power to the wheels than typical spur, planetary and bevel gear transmission.

The M-15B has a 10-cu ft concrete bucket which is quickly interchangeable with two sizes of flatbeds on the same chassis for hauling brick, block, tile, lumber and other construction materials. **The Prime-Mover Co., CE-5, Muscatine, Iowa.**

Ornamental Grille

A NEW ORNAMENTAL GRILLE of honeycomb design, which fulfills a need that has long existed for large, maintenance-free screens for structures of the magnitude and character of modern buildings, is now being manufactured.

"Aluminum Gridsteel" is a very versatile material which can be furnished in either rigid or flexible panels of various sizes, lending itself to curved or flat applications, for interior as well as exterior uses, such as sun deflectors, curved or flat screens, wall panels, canopies, decorative trim and contoured ceilings. It may be imbedded in floors or ceilings where the hexagonal pattern will suggest a mosaic tile effect. The grille is available in colors through anodizing, or it may be painted when changes in color motif are

(Continued on page 146)

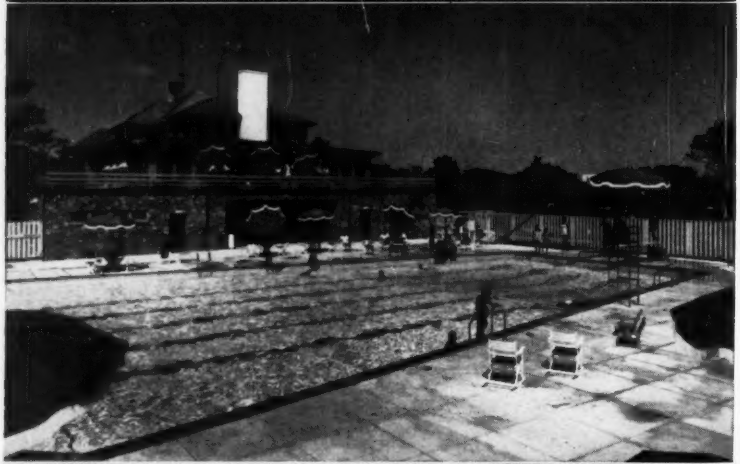
contemplated from time to time. Also, advantage may be taken of the reflectivity of the bright and attractive natural aluminum by having it furnished in mill finish, clear lacquered, or clear anodized. Some beautiful effects may be obtained by filling it with plastic or covering the mesh with translucent plastic sheeting, frosted glass or other material. **Irving Subway Grating Co., Inc., CE-5, 50-39 27th St., Long Island City, N. Y.**

Air:Seal Airhouses

Inclement weather, long a major problem to contractors, can now be controlled by the builder at any construction site thanks to development of practical air supported structures.

The shelters, called Air:Seal airhouses, are designed to withstand adverse temperatures, near hurricane force winds and other extreme climatic conditions while protecting workmen and equipment inside.

Supported solely by air pressure, the vinyl impregnated nylon domes have no interior props or poles to interfere with the work being conducted inside. The airhouses are fastened to the ground by one of three methods: interlocking metal ballast strips bolted to a concrete foundation, or by a pipe ballast ring attached by cables to either deep soil spears or to a number of large wooden pallets weighted down with sand bags. **Seattle Tent and Awning Company, CE-5, 310 Westlake North, Seattle 9, Wash.**



Cork Expansion Joint

An exclusive design in cork expansion joints for concrete has been developed to meet the requirements of Special Provisions of the Bridge Department of the State of California.

The resultant product, called Naco Cork Expansion Joint, will compress to ½ its thickness under a load of 50 lb per sq in. With release of the pressure, the product will return to within 95% of its original size.

Superior Handling Qualities

The cork is asphalt impregnated and encased within 15-lb felt. It is reported to weather well and to have superior handling qualities. **National Expansion Joint Company, CE-5, 1601 Embarcadero Road, Oakland, Calif.**

EQUIPMENT MATERIALS and METHODS

(continued)

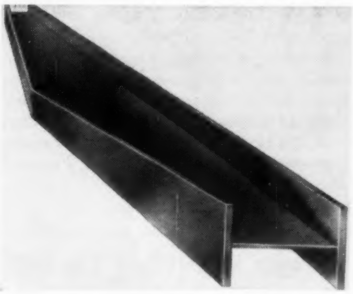
Super-Tough Aluminum Hat

A new super-tough aluminum, lightweight safety hat is now available for the oil field and construction worker, road equipment operator, lumber dealer, employer or farmer.

Constructed with full brim for added protection to neck, ears and shoulders, this sturdy shell is formed in one piece from a strong aluminum alloy, and is ribbed for increased strength; the edges are completely rolled for extra rigidity in the brim. The aluminum shell is supported on the new Geodetic suspension, which dissipates impact shock waves over a wide area of the head. It is constructed to conform to the head of any worker and resists the tendency of the hat to shift, tilt or crash against the skull under angular blows. **Willson Products Division, Ray-O-Vac Company, CE-5, 212 E. Washington Ave., Madison 10, Wis.**

Tapered Girder

An economical new section for roofs and floors of industrial, commercial and public buildings, the Tapered Girder consists of three plates—top and bottom flanges and web, which may be varied in size according to structural needs. By varying the taper, inverting the beam, cantilevering and by other combinations of tapered girders, many types of roof and floor systems are made practical. The low-cost Tapered Girder is fabricated from stock steel plates to insure the fastest possible delivery to the job site.



Functional Appearance

With its clean lines and functional appearance, the Girder is ideal for exposed construction of all kinds. It also offers a higher carrying capacity than rolled sections with the same weight of steel. Maximum economy is obtained by varying the slope in accordance with the load requirements. **Shlagro Steel Products Corporation, CE-5, Somerville 43, Mass.**

Surveying Instrument

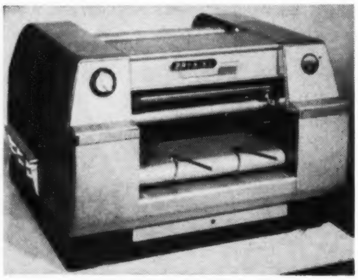
An improved surveying instrument for measuring distance electronically has been developed. Called the Geodimeter Model 4a, it permits faster measurement of unknown distances. Readability has been improved by the device's new reading dial that is graduated every ten divisions. Pointing time also is reduced as much as 25% through the use of an enclosed coarse pointing sight. **The Geodimeter Company, CE-5, 2013 Park Ave., South Plainfield, N. J.**

Diazo Copying Machine

Designed principally for office use, the Copyflex Model 120 diazo copying machine copies translucent and semi-translucent originals at a cost of approximately 1¼ cents a copy.

The manufacturer states that the machine is the first table-top copying machine to feature automatic separation of copies from originals before delivery. The copies and originals are separated and stacked without any need of handling by the operator.

The 120's high printing speed can produce hundreds of letter-size copies per hour. Its streamlined operation requires no stencils or masters, no transfer sheets, and no peeling of transfer sheets. In addition, sensitized materials are handled only once.



High Printing Speed

Approximately the size of a typewriter, the Model 120 was designed for low cost, systematic reproduction of paperwork. It is especially useful for speed and economy in such operations as order-invoices, purchasing-receiving, customer statements, sales reports, accounting, internal communications, personnel records, small engineering and architectural drawings, and general copying. **Charles Bruning Company, Inc., CE-5, Mount Prospect, Ill.**

Hexagon Socket Head Cap Nuts

A line of large hexagon socket head cap nuts and bolts especially adapted to applications where close bolting is required is now available.

The internal socket head wrenching feature permits a compact design and allows large nuts and bolts to be positioned closer to any corner, shoulder or pocket than possible with externally wrenched nuts and bolts.

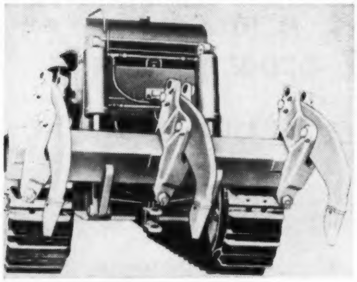
The nuts and bolts are suitable for many types of heavy machinery and construction applications such as turbines, high pressure heat exchangers, bridges and locks. When used on high pressure

(Continued on page 149)

equipment, the socket heat fasteners can be positioned with minimum space between the socket head cap nuts to permit high pressure design. **Jos. Dyson & Sons, Inc., CE-5, 5125 St. Clair Ave., Cleveland 3, Ohio.**

Hydraulic Ripper

THE NEW HYDRAULIC RIPPER for the International Harvester TD-25 has adjustable shanks for various ripping depths. Adjustments are made quickly and easily by changing the position of movable pins in the swing brackets. Shanks swivel 15 deg in either direction to allow points to "float" beneath the ground, seeking out cracks and weak points in rock. Points have a live action resembling that of a jackhammer and are completely replaceable.



Adjustable Shanks

Called "The Brute", the ripper is stronger and heavier to permit operators to take full advantage of the increased power of the new IH TD-25. Ripper and tractor weights are balanced, resulting in greater traction and more usable horsepower.

Included in the new designs are straight shanks in 24-in., 42-in., and 48-in. digging lengths; curved shanks in 24-in. lengths for use on non-blocky or non-slabby materials; and a new push block which can be attached straddling the center shank and swing beam for booster ripping. **The Greenville Steel Car Company, Earthmoving Equipment Div., CE-5, Greenville, Pa.**

Material Spreader

OUTSTANDING FEATURES OF THE Model "TCS" Material Spreader is its one man operation, full 8-ft spreading width, and accurate metering of materials from 5 to 70 lb per sq yd.

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EQUIPMENT MATERIALS and METHODS

(continued)

The spreader offers one of the quickest, surest gate settings on the market, according to the manufacturer. Crank the calibrated dials for correct depth of spread, lock the jack and you're ready for spreading. A single lever activates the transmission, agitator and conveyor. The extended handle on automatic hitch gives fast, safe hook-ups. **Highway Equipment Company, Dept. H8, CE-5, 616 "D" Ave., N.W., Cedar Rapids, Iowa.**

Ultrasonic Flowmeter

Developed to field-test large water meters already in place as well as to check the flow of liquids in pipe lines and fire protection systems, the ultrasonic flowmeter employs high-intensity sound waves transmitted through the walls of the pipe to the flowing liquid. No mechanical devices are employed inside the pipe line.

The new unit consists of two basic units, the first of which is a short piece of pipe the same length as a standard valve. This pipe has two sets of small transducers on the outside but nothing on the inside. It will be permanently installed near a meter, or in some other suitable location in the system.

Consists of Two Units

At any time the flow in the line is to be determined, the operator connects to the transducers a pair of wires, up to 100 ft or more in length if desired, and reads directly from a portable electronic transceiver the instantaneous flow rate, and totalized flow over any given period, with a strip chart record available as well. **Gulton Industries, Inc., CE-5, 212 Durham Ave., Metuchen, N. J., and Hersey-Sparling Meter Co., CE-5, 250 Elm St., Dedham, Mass.**

Films Available

"OLD AS THE HILLS"—A new motion picture shows how Nature, in roaring mountain streams, angry seas and eroded hills taught the lesson of abrasion, then in deposits of natural abrasives provided the material for Man's first grinding needs—sharpening crude tools and polishing armor. The film then goes on to outline Man's progress in adapting the lessons and materials of the earth in shaping his own environment to match his growing needs and desires. **Norton Company, CE-5, Worcester 6, Mass.**

"BUILDING WEATHER"—Latest results of a continuing study into the problems involved in insulating air conditioning systems have been incorporated into a sound film entitled "Building Weather." A non-commercial, technical presentation covering the development of normal inside design conditions along with a review of many of the problems involved in insulating air conditioning systems, the motion picture lists the cause of moisture problems and gives a number of suggestions for eliminating or minimizing them. **Armstrong Cork Company, Dept. BW, CE-5, Lancaster, Pa.**

"THE EIMCOBELT STORY"—A new 16-mm. sound and color motion picture on the operations of the EimcoBelt continuous belt drum filter discloses the equipment's new operating principle in an animation sequence and how this important breakthrough in filtration was developed and perfected by the company's engineers and researchers. The movie also demonstrates the filter's ability to remove the medium from the drum every filter cycle for cake discharge and cloth washing, enabling it to maintain a clean filter medium, even handling glutinous materials of slurries containing low density solids. **The Eimco Corporation, CE-5, P.O. Box 300, Salt Lake City 4, Utah.**

"MAGIC HIGHWAYS—U.S.A."—A 30-minute, 16-mm color film complete with sound track produced by Walt Disney, is being offered at no charge for showing before traffic engineering and highway groups. Created for television on the noted "Science" series, it traces the growth of the American highway system from 1901 to the present, and projects it into the future. Problems of traffic growth and control are fully treated, with various newly developed devices and techniques, dramatically presented. **California Metal Enameling Co., CE-5, 6904 E. Slauson Ave., Los Angeles 22, Calif.**

Literature Available

Well-Drilling—A 12-page Well Drilling Bulletin for Water Wells and Shallow Oil Wells describes the new highly-mobile, over the highway Trucm-3 Drillmaster unit, designed to utilize the company's Downhole drill. It includes procedures for water wells and shallow oil wells and gives typical cost analysis comparisons for both types of jobs. **Ingersoll-Rand Co., CE-5, 11 Broadway, New York 4, N. Y.**

Technical Data Catalog—A newly revised catalog for 1960 of Pocket Size Technical Data Books, selling at $1.25 each, is available. Every field of engineering is covered for constant use to engineers, technical men, surveyors, shopmen, teachers and students. The material includes information on Automotive Engineering, Diesel Engineering, Machine Design, Machinists Data, Power Transmission Machinery, Steam Engineering, Machine Design, Architecture, Builders Data, Reinforced Concrete and Conversion Tables. **Lefax Publishers, CE-5, Philadelphia 7, Pa.**

Nuclear Training Center—Bulletin 131 describes a complete radioisotope laboratory for high school and college science programs. It is Model 4000 Nuclear Training System, an integrated system of instruments, radiochemicals, and laboratory accessories for teaching radioisotope applications in chemistry, physical science, and life science courses. The brochure gives details and specifications on each instrument in the system, which consists of a decade scaling unit, a Geiger tube with sample holder and mount, a digital timer, 100 sample pans, a micropipette and syringe, instruction manuals, eight license exempt radioactive reagents, and a manual of experiments and review articles. **Nuclear-Chicago Corporation, CE-5, 359 East Howard Ave., Des Plaines, Ill.**

Crack-Resistant Patching Material—The advantages of Thoropatch, a new crack-resistant patching material for concrete, brick and masonry which finishes to a natural cement color, are described in a 4-page folder. A series of photographs shows how to use it for faster industrial repairs and tough, feathered edges. The booklet also gives actual test results for tensile strength, compressive strength, density and flexural strength as well as immersion test results for many acids and other corrosive materials. **Standard Dry Wall Products, Inc., CE-5, New Eagle, Pa.**

P-Kay Slab Bolsters—Literature is offered on P-Kay Slab Bolsters, the solid polyethelene bar supports designed to hold the reinforcing bar in the slabs, columns and beams, both in the plant and on the job. The bar is easily snapped into place, and rigidly maintains utmost stability under normal pouring conditions. Architects' and contractors' worries about rust can now be entirely forgotten as polyethelene cannot rust. They are light in weight and have been developed and tested under the most exacting standards. Information is also available on Nox-Crete Maintenance Coating and Nox-Crete Form Coating. **Universal Builders Supply Co. Inc., CE-5, 787 United Nations Plaza, New York 17, N. Y.**

Fasteners Standardization Report—According to a special review article published by Fasteners Magazine, the Fasteners Industry is the outstanding example of standardization leadership. The purpose of the review is to acquaint engineers, designers and others with the basic fastener standards and specifications and give some idea of their scope and where they may be obtained. More than 400 plants are producing fasteners in this country today and their product adds up to 100,000,000,000 parts annually. Literally hundreds of fastener standards are published in this country covering this vast production, and these are classified in three groups—National, Industry and Company, and cover both general-purpose and special fasteners. **Industrial Fasteners Institute, CE-5, 1517 Terminal Tower, Cleveland 13, Ohio.**

Lightweight Fireproofing with Perlite—The eighth edition of "Lightweight Fireproofing with Perlite" describes 41 approved fire rated construction systems with Perlite plaster and concrete. These systems consist of fireproofing details up to 5 hours for steel columns, walls and partitions, floors and ceilings. Details are also given for up to 4-hour rated systems for direct-to-steel fireproofing applications with perlite accoustical plaster. **Perlite Institute, Inc., CE-5, 45 W. 45th St., New York 36, N. Y.**

Hand Chain Hoists—A new 8-page booklet entitled "HMA-200 Standard Specifications for Hand Chain Hoists" contains tables and recommended minimum standards on differential, worm-geared and spur-geared (or equivalent) types of hand chain hoists; hook or lug suspension and plain or geared trolley. **Hoist Manufacturing Association, Inc., CE-5, One Thomas Circle, Washington 5, D. C.**

Thermal Insulation Catalog—Thermal insulations for all types of commercial and industrial requirements, in applications ranging from −400 deg F to 3000 deg F, are described in a 54-page catalog. Entitled "Insulation Product Information", it contains six complete sections, each devoted to a specialized group of thermal insulations, including industrial and high temperature; plumbing, heating, and air conditioning; and refrigeration. **Johns-Manville Sales Corp., CE-5, 22 East 40th St., New York 16, N. Y.**

From the MANUFACTURERS

CANADIAN SUBSIDIARY: The first Canadian branch of Economy Forms Corp., Des Moines, Iowa, is now operating in Oshawa, Ontario, under the name Economy Forms of Canada, Ltd. The company will distribute EFCO Steel Forms and accessories for concrete construction . . . **CONTRACTS AWARDED:** The Atomic Energy Commission has awarded the Blaw-Knox Co., Pittsburgh, Pa., a contract to conduct a study of the facilities required for testing an experimental indirect-cycle aircraft reactor. The purpose of the study is to establish a basis for determining the most economical and practical method of providing the facilities needed for the testing program to be conducted as part of the Commission's Aircraft Nuclear Propulsion Program . . . The Kreisler-Borg Construction Co. of White Plains has been awarded the general contract for the construction of alterations and an addition to the Hawthorne Jr. High School in Yonkers, N. Y. The building will be constructed from plans drawn by Maurice A. Capobianco, A.I.A. Architect of Yonkers at a contract price of $745,100.00. The total cost of the project with the mechanical contracts comes to $1,213,703.00. . . . **ACQUIRES BUSINESS:** All-Steel Equipment Inc., Aurora, Ill., a leading manufacturer of residential and commercial wiring receptacles, as well as metal office furniture and equipment, has purchased the assets and business of the Conduit Fittings Division of U. S. Industries, Inc. . . . **DISTRIBUTORS APPOINTED:** The appointment of Akron Welding & Spring Co., Akron, Ohio, as a distributor for its heavy-duty industrial flooring products was announced by officials of Walter Maguire Co., Inc. . . . Wood Tractor Co., Portland, Ore., has been appointed distributor by the Parsons Co., Newton, Iowa, a division of Koehring Co. The new distributor will sell and service the complete line of Parsons ladder and wheel-type trenchers . . . **DIVISIONS FORMED:** Pacific Wire Rope Co., Los Angeles, announces the formation of a Specialty Products Division with four departments. The newly-formed division was created to meet the need for material handling equipment by industries on the West Coast . . . Formation of a new K&E Optics and Metrology Division was announced. The division will specialize in the development and manufacture of optical, mechanical and electronic systems and components for precise measurement of lengths and angles . . . **NEW FACILITIES PLANNED:** Permanente Cement Company will invest approximately $16,000,000 for new and improved facilities in 1960, compared with $10,-337,000 in 1959. Included are completion in August of a cement manufacturing plant near Honolulu, Hawaii, and a gypsum plant in New Mexico in May . . . **PUSHBUTTON COMMUNICATIONS SYSTEM:** A pushbutton communications system linking 43 plants, laboratories and branch sales offices in 17 states has been placed in operation by Minnesota Mining and Manufacturing Co. The system speeds transmission of messages and orders and means a further improvement in service to 3M customers . . . **EXPANSION PROGRAMS:** Construction has begun on a $250,000 expansion program at the Smith & Loveless manufacturing plant near Lenexa, Kansas. The company manufactures factory-built sewage lift stations and sewage treatment plants for municipal, suburban and industrial use and is a division of Union Tank Car Company, Chicago . . . **RESIGNATION:** Leland Lyon has resigned from the board of Directors of Atlas Powder Co., after 42 years' service on the board and an active career in the explosives and chemical industries spanning 62 years . . . **NAME CHANGES:** United Research Corp. of Menlo Park, Calif., has changed its name to United Technology Corp. It is said that the name change was made primarily because the word technology describes in a much more definitive manner the work and scope of activities the company is undertaking . . . Southern Lightweight Aggregate Corp. has changed its name to Solite Corporation . . . **APPOINTMENTS:** Donald Palmer has been elected Executive Vice President of C. H. Wheeler Mfg. Co., Philadelphia, Pa. . . . Koh-I-Noor Pencil Co., Bloomsbury, N. J., has announced the appointment of Paul E. Gundacker as New York area Sales Manager.

PROCEEDINGS AVAILABLE

March

2423. Mean Direction of Waves and of Wave Energy, by Omar J. Lillevang. (WW) Reliable predictions of erosion/accretion effects of new coastal works are necessary. A vector technique related to wave direction and duration statistics is devised, tested on Santa Barbara historical shoaling records, and demonstrated as a design aid for a small craft harbor plan on a sandy beach of California coast.

2424. Diffusers for Disposal of Sewage in Sea Water, by A. M. Rawn, F. R. Bowerman and Norman H. Brooks. (SA) This paper includes a history of the ocean outfall system operated at Whites Point, California, by the Los Angeles County Sanitation Districts; an outline of certain techniques developed to predict dilutions of sewage effluent discharged in sea water; a description of the use of multi-port diffusers for improving initial dilution; and a procedure for successful hydraulic design of large diffusers.

2425. Discussion of Proceedings Paper 1984, 2089, 2252. (SA) A. L. Tholin, Clint J. Keifer on 1984. C. H. Lawrance and D. R. Miller on 2089. Ralph Stone on 2252.

2426. Discussion of Proceedings Paper 1935, 1962, 1994, 2085, 2129, 2147, 2148, 2149, 2201, 2310, (HY) Robert G. Cox, Arthur Toch, Thomas J. Rhone on 1935. Walter L. Moore on 1962. Manuel A. Benson on 1994. Tojiro Ishihara, Yuichi Iwagaki, Yoshiaki Iwasa on 2085. B. Michael and A. R. Gagnon on 2129. Julio Escobar-Fernandez on 2147. A. R. Chamberlain, Nicholas Bilonok on 2148. Steponas Kolupaila, Israel H. Steinberg, William C. Peterson on 2149. Fred W. Blaisdell on 2201. Michael Amein on 2310.

2427. Discussion of Proceedings Paper 1940, 1943, 2004, 2163. (ST) John A. Sbarounis and Michael P. Gaus on 1940. F. G. Keller on 1943. S. O. Asplund on 2004. A. A. Eremin, Theodore V. Galambos on 2163.

April

Journals: Engineering Mechanics, Hydraulics, Power, Soil Mechanics and Foundations, Structural.

2428. The Impact of Computers on Engineering Education, by Gordon P. Fisher. (ST) The modern electronic computer is having a significant effect on the engineering profession. This effect, naturally, is felt in the engineering schools. In this paper the influence of the computer on (a) curriculum, (b) research, and (c) relations with engineering practice, is examined.

2429. Conservancy Districts as Flood Control Organizations, by Cloyde C. Chambers. (HY) A well designed conservancy district is a valuable organization for developing, constructing and administering a comprehensive water management program for an intrastate watershed. Evidence indicates that this type of organization is well adapted to the solution of flood problems, especially when approached on a drainage area basis.

2430. Furnas Hydroelectric Project, by James W. Libby. (PO) This paper gives background data and describes the general design arrangement of the Furnas Hydroelectric Project, now under construction on the Rio Grande. Ultimately, Furnas will have an installed capacity of 1,200,000 kw, placing it among the world's largest hydroelectric developments.

2431. Soil Structure and the Step-Strain Phenomenon, by D. H. Trollope and C. K. Chan. (SM) Following recent advances in the field of colloid science, a working hypothesis aimed at describing the make-up of stable soil structures has been developed. In the light of this hypothesis, the mechanism of shear failure in soils and their response to long-term sustained and repeated loads has been studied.

2432. Piratininga Steam-Electric Generating Station, by O. L. Hooper and H. M. Estes. (PO) This paper describes the construction of the Piratininga steam-electric generating station and the hydroelectric system of which it forms a part. Particular attention is given to the problems of transportation which are unique to the location.

2433. Distribution of Extreme Winds in the United States, by H. C. S. Thom. (ST) Following previous work, annual extreme wind-speed data for airposts in the United States were corrected for anemometer type and reduced to a standard 30-ft elevation. The Fisher-Tippett Type II distribution was fitted, giving 0.50, 0.20, and 0.01 quantiles. Confidence intervals of 0.90 for the quantile isolines, and a nomogram for conversion of quantiles to desired elevations, are developed.

2434. White Noise Representations of Earthquakes, by G. N. Bycroft. (EM) White noise is a suitable representation of earthquake motion. A white-noise source, used in conjunction with an analog computer, is a convenient method of analyzing structures subjected to complex ground motions and of assigning probabilities to the deformations arising. It is suggested that a "standard large earthquake" be represented by "white" ground accelerations having a flat spectral density of 0.75 ft per sec per cps and a duration of ½ min.

2435. Hydroelectric Possibilities and Influence of Load Growth, by S. P. McCasland. (PO) This paper is devoted to the physical and economic enhancement that is imparted to hydroelectric potentialities by expansion of power markets. Emphasis is given to economic improvements which small undeveloped sites derive from increase in demand.

2436. Effect of Floor Systems on Pony Truss Bridges, by Robert M. Barnoff and William G. Mooney. (ST) This paper presents the results of an analytical and experimental study of the effect of floor-system participation on top-chord stresses in pony truss bridges. An analytical method is developed to calculate the increase in top-chord stresses due to floor-system participation. Although the results of the tests apply only to a single-span pony truss bridge model, with continuous stringers, these results can probably be extended to include full-scale bridges.

2437. Dynamic Effects of Earthquakes, by Ray W. Clough. (ST) The principle factors controlling the dynamic response of structures to earthquakes are summarized in this paper, and are related to the lateral force provisions recently recommended by the Structural Engineers Association of California for inclusion in the Uniform Building Code.

2438. A Comparison of Stream Velocity Meters, by F. Wayne Townsend and F. A. Blust. (HY) A description of the U. S. Lake Survey method of making stream flow measurements is given, and comparisons of current velocities simultaneously measured by cup and screw type current meters in the lower Niagara River are presented. The conclusion is that the two types of meters give identical results in Lake Survey flow measurements.

2439. Strength and Efficiency Aspects of Plate Structures, by George Gerard. (EM) Two recent developments that may be of interest in the design of thin-gage metal structures are presented. The first part of the paper is concerned with the compressive-strength analysis of long flat plates after elastic buckling occurs. The second part of the paper considers the design rather than the analysis of composite stiffened plate structures subject to instability.

2440. Dynamic Analysis of Elasto-Plastic Structures, by Glen V. Berg and Donald A. DaDeppo. (EM) A numerical method is presented for determining, by high-speed digital computer, the response of an elasto-plastic structure of a finite number of degrees of freedom to dynamic loads. Damping, either linear or nonlinear, may exist. The method consists of numerical integration combined with a matrix solution for the elasto-plastic constraints. Uniqueness of the elasto-plastic solution is proved.

2441. Discontinuity Stresses in Beams on Elastic Foundation, by Joseph Penzien. (ST) Presented is a method of analysis for obtaining discontinuity stresses in beams on elastic foundation and cylindrical shells, subjected to axisymmetrical loading. Also presented are the solutions of numerous basic cases which provide the necessary numerical constants required in the proposed method of analysis.

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2442. Pile Driving Experiences at Port Everglades, by T. J. Lynch. (SM) Material settlements of piles were unusual circumstances which developed during the construction of foundations for the Port Everglades Plant. This paper outlines the soil investigations, the difficulties encountered in the driving of piles, and the pile settlements. Pile-load test data are presented and records of comparative driving with an air hammer and a rated equivalent (30,000 lb-ft) diesel are included.

2443. Effects of Flood Flow on Channel Boundaries, by D. A. Parsons. (HY) Some observations of flood-flow effects on natural stream-channel boundaries are given. The general nature of stream flow and stream channels is also included, with the objective of improvements in the design of channel stabilization measures.

2444. Preliminary Analysis of Continuous Gable Frames, by James W. Gillespie and Jan J. Tuma. (ST) Tables and charts for the preliminary analysis of continuous gable frames are presented. The study is restricted to two, three and four equal-span frames of constant cross section, subjected to uniformly distributed loads. All relationships are based on the assumption of elastic deformation. Numerical examples are given.

2445. Behavior of Buckled Rectangular Plates, by Manuel Stein. (EM) A review is presented of recent work done on the post-buckling behavior of rectangular plates. Theoretical and experimental results, which indicate possible changes in buckle pattern, are given for simply supported plates in longitudinal compression. Results of an analysis of the phenomenon of change in buckle pattern are presented and interpreted. An analysis of the stiffness in shear of a plate buckled in compression is presented.

2446. Design of Prestressed Concrete Beams by Computer, by Joseph J. Bonasia. (ST) This paper illustrates how an electronic digital computer is advantageously used to select and design standard post-tensioned, prestressed concrete beams. Two charts are presented which provide information for the rapid selection of satisfactory beams used as interior stringers in simple span, composite beam highway bridges with AASHO H20-S16-44 live load. A description of the method of obtaining the required prestressing force and its location for the results obtained is also presented.

2447. Waves and Shocks in Locking and Dissipative Media, by Mario G. Salvadori, Richard Skalak and Paul Weidlinger. (EM) The propagation of stress waves and shocks in various inelastic media are studied for a semi-infinite body loaded at its free surface. The first type of material postulated is a locking medium, which responds elasto-plastically at low stress levels but behaves as a rigid body after it is compressed to a certain maximum strain. The second type of medium studied exhibits a constant modulus of elasticity on initial loading and a second larger on unloading.

2448. Drag Coefficients of Locomotion Over Viscous Soils, by Ervin Hedges and Robert S. Rowe. (SM) Supersaturated viscous mud overlaying a hard bottom is often critical to locomotion in many areas. To solve wheel resistance problems, basic principles of hydro-dynamics may be applied. A study of the problem with the purpose of minimizing drag in viscous soils is suggested.

2449. Friction Losses in Lines with Varying Discharge, by David L. Muss. (HY) The determination of friction losses in water mains is complicated by service connections along the line which result in different flows in each section of the pipe. Methods now in use result in errors ranging from −66.9% to +185%. New methods are proposed which would reduce the error to less than 5.5%.

2450. Digest of the Guide to Design Criteria for Metal Compression Members, by Bruce G. Johnston. (ST) Eleven highlights from the forthcoming CRC "Guide to Design Criteria for Metal Compression Members" are presented. These items are, in general, the simpler and less technical aspects of the Guide. They were chosen because they represent contributions to the current status of metal compression member design.

2451. Radioactive Traces in Hydrometeorology, by L. Machta. (HY) Atmospheric motion is studied with the aid of radioactive tracers. Radioactive materials are used to improve the meteorologist's ability to track the path of masses of water in the atmosphere. The most promising tracer seems to be tritium but the large number of sources of tritium complicates its application to hydrological problems.

2452. Sediment Problems of the Lower Colorado River, by Whitney M. Borland and Carl R. Miller. (HY) The closure of Hoover Dam on the Lower Colorado River and the subsequent construction of other major structures, downstream, instigated a series of river adjustments that have required corrective or protective measures. Some of the major problems which have been encountered are pointed out, methods of rectification and design considerations are discussed, and some of the results that have been obtained are presented. Some probable future river problems are briefly examined.

2453. Commentary on Plastic Design in Steel: Connections, Progress Report No. 6 by the Joint WRC-ASCE Committee on Plasticity Related to Design. (EM) This paper is the sixth in a series of reports on plastic design emanating from a joint committee of WRC and ASCE. It analyzes the behavior of continuous connections used in plastically designed structures, including corner connections, interior beam-to-column connections and tapered and curved haunches.

2454. Commentary on Plastic Design in Steel: Deflections, Progress Report No. 7 of the Joint WRC-ASCE Committee on Plasticity Related to Design. (EM) This paper is the seventh and last in a series of reports on plastic design emanating from a joint committee of WRC and ASCE. It presents the analysis of deflections in the plastic range and points out that deflections at working load of plastically designed structures are not excessive.

2455. Discussion of Proceedings Paper 1990, 2197, 2198, 2220, 2230. (EM) T. V. Galambos and Robert L. Ketter on 1990. Glen V. Berg and Spiro S. Thomaides, T. K. Caughey, G. W. Housner and D. E. Hudson, O. A. Glogau on 2197. John C. Sprague, H. Norman Abramson on 2198. Bayliss C. McInnis, Steven Likuan Tsai and James R. Sims, Clarence J. Derrick, Glen V. Berg on 2220. M. N. Fialkow on 2230.

2456. Discussion of Proceedings Paper 2148, 2150, 2200, 2224, 2241, 2335, 2336. (HY) W. O. Ree on 2148. Mikio Hino, Takashi Ichiye, Charles G. Gunnerson on 2150. M. B. McPherson, Ernest E. Brodbeck on 2200. A. Thiruvengadam, M. B. McPherson, Warren H. Kohler on 2224. A. Thiruvengadam on 2241. J. W. Johnson on 2335. Bernard L. Golding on 2336.

2457. Discussion of Proceedings Paper 1734, 1946, 2206, 2228, 2286, 2289. (PO) Vilgot Lanner, Torald Mundal on 1734. Clifton W. Bolieau on 1946. Bryant Mather on 2206. John H. Ruskin on 2228. G. S. Sarkaria and O. S. Hom on 2286. Carlos S. Ospina on 2289.

2458. Discussion of Proceedings Paper 1970, 2037, 2218, 2219, 2221, 2222, 2314, 2347, 2350, 2351. (ST) W. H. Munse, K. S. Petersen and E. Chesson, Jr. on 1970. Charles O. Heller on 2037. J. Szabo, E. A. Richards on 2218. C. J. Posey on 2219. A. A. Eremin, Benjamin Koo on 2221. W. H. Munse on 2222. Jan J. Tuma on 2314. Nicholas Esquillan on 2347. Charles E. L. Massonnet on 2350. Bruno Thurlimann on 2351.

2459. Discussion of Proceedings Paper 2062, 2135, 2210, 2213, 2217. (SM) Frank D. Masch on 2062. Kurt H. Siecke, David M. Greer, R. C. Harlan, Louis J. Goodman and Charles N. Lee, F. H. Kellogg and E. L. Murphree, Jr., Lev Zetlin, Bramlette McClelland, James Chinn on 2135. John A. Focht, Jr., on 2210. P. J. Moore, Gideon Yachin on 2213. H. R. Cedergren, Max Suter on 2217.

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